Formulating Disaster Recovery Plans for New Zealand: using a case study of the 1931 Napier Earthquake

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Abstract

Worldwide, the risks from natural and technological hazards has been mounting at an accelerating rate, improvements in forecasting and warning systems have reduced deaths, however monetary losses from disasters are overwhelming (Burby, 2004). Pre event planning for recovery helps to resolve issues before a disaster so recovery is more efficient and effective. It also ensures that the window of opportunity can be used to implement hazard mitigation measures to reduce the vulnerability of the area with the aim of improving resilience for the next disaster.

International case studies were examined, the Northridge earthquake being the most successful recovery while Hurricane Katrina the least. The recovery of the Napier 1931 earthquake was chosen as a New Zealand case study; to date this is the country's worst disaster. Overall the recovery of Napier was a success, shops were opened in temporary premises to keep the economy going and mitigation measures were included in the rebuilding. The earthquake has had important flow on effects on the way that disasters are managed in New Zealand. To create pre event plans in New Zealand legislation needs to be modified, including recovery plans and development of shortcuts to reduce some procedures which lengthen the recovery process. These plans need to take into account our national vulnerability as well as regional vulnerabilities.

Chapter 1 - Introduction

A natural hazard becomes a disaster when it affects a community that is exposed and vulnerable (Uitto, 1997, Alexander, 1993 in Cross, 2001). World-wide, the risks from natural and technological hazards has been mounting at an accelerating pace, improvements in forecasting and warning systems have reduced deaths, however monetary losses from disasters are overwhelming (Burby, 2004). As the population of the world increases there is increasing pressure on cities to expand to accommodate the growing population, land is progressively becoming more of a scarce resource for housing, business, infrastructure, tourism or agriculture. For this reason development often occurs on land subject to natural hazards, so this investment adds to the cost of disasters. As time has gone on more information can be found about what causes natural hazards. This information can then be used to help cities prepare for natural hazards so that the effects will be lessened. Therefore to reduce the risk from natural hazards mitigation measures can be employed. Often the best time to accomplish this is during the window of opportunity which exists after one disaster and before the next.

The majority of cities around the world were founded before there was any knowledge of how natural disasters like earthquakes, tsunamis and volcanoes occur. However, historically, some communities have been located to reduce risks, for example Italian hill towns were located on high ground to avoid flooding and diseases such as malaria which were widespread on valley floors (Burby, 2004).

Disasters disrupt communities by interrupting day to day life and damage the infrastructure and services that communities rely on to function.

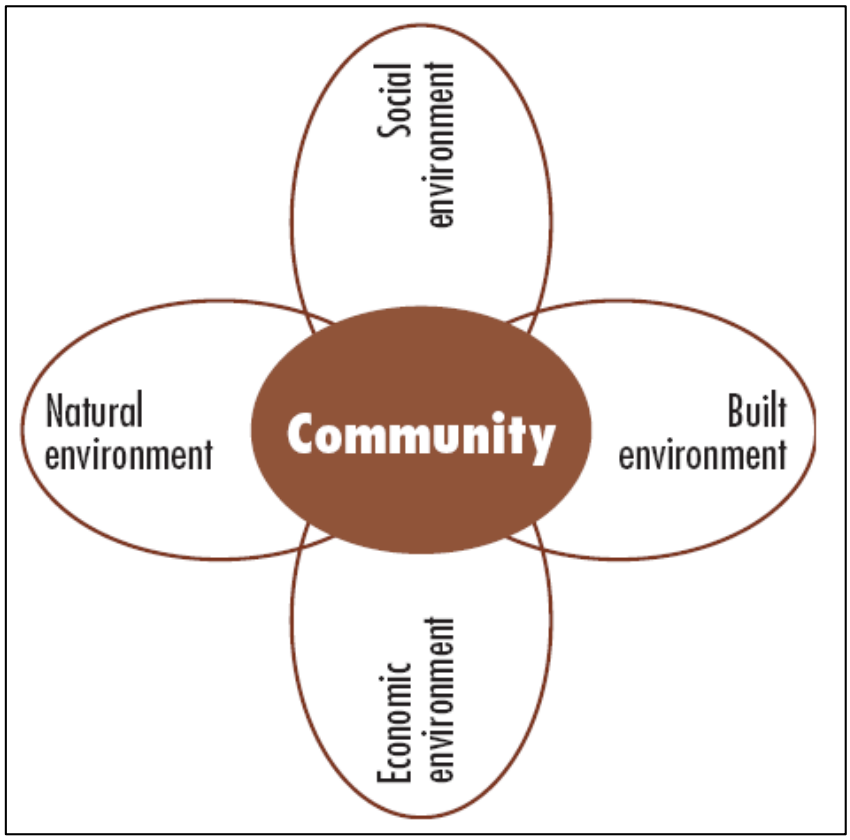

Figure 1 Components of a community (MCDEM, 2005)

Communities are composed of 4 environments: Social, Built, Natural and Economic (see Figure 1). All of these environments will be affected differently by a disaster and this will affect how they interact with other environments. Recovery from a disaster is therefore complex and needs to involve communication and coordination between these different components (MCDEM, 2005).

Review of Literature

Recovery

Recovery is defined as '*the coordinated efforts and processes to effect the immediate, medium and long term holistic regeneration of a community following a disaster*' (MCDEM, 2005). Therefore the concept of recovery combines Reconstruction, (rebuilding of buildings and infrastructure), Restoration, (pre-impact physical and social patterns) and Rehabilitation, (restoration of physical and social patterns to a higher level) (Quarantelli, 1999).

Limited thought was given to the concept of recovery before the 1970s however studies in recovery have increased since the 1980s (Becker et al, 2006; Quarantelli, 1999). Haas et al (1977) divided the concept of recovery into 4 major phases:

1. Emergency Period
2. Restoration Period
3. Replacement Reconstruction Period
4. Commemorative, Betterment or Developmental Reconstruction Period

These four phases are shown in Figure 2 below. The phases have overlap periods as one phase begins to change into another. The length of each phase, except for the last is roughly ten times as long as the previous (Vale and Campanella, 2005; Haas et al, 1977). The emergency period is categorised by loss of life, searching and caring for the injured and the beginnings of debris clearing. The end of this phase is usually signalled by the cessation of search and rescue efforts, reopening of main streets and a reduction in emergency housing and feeding.

Restoration, the second phase, is where the key urban services are re-established, displaced people return and debris is cleared. Depending on the resources available this phase may last from a few months to more than a year. The third phase, replacement reconstruction phase, consists of rebuilding capital stock to pre-disaster levels and the return of the population. Where a high death toll has been experienced this usually means the area once again contains adequate housing, jobs and amenities to support the pre-disaster population (Vale and Campanella, 2005). As this activity occurs economic and social activity will return to pre disaster levels. The final stage of recovery is the commemorative, betterment and development reconstruction phase. This often involves large development projects which serve three varied but often interconnected functions, to memorialise the disaster, mark the cities post disaster improvement or to serve the future growth and development of the community (Vale and Campanella, 2005).

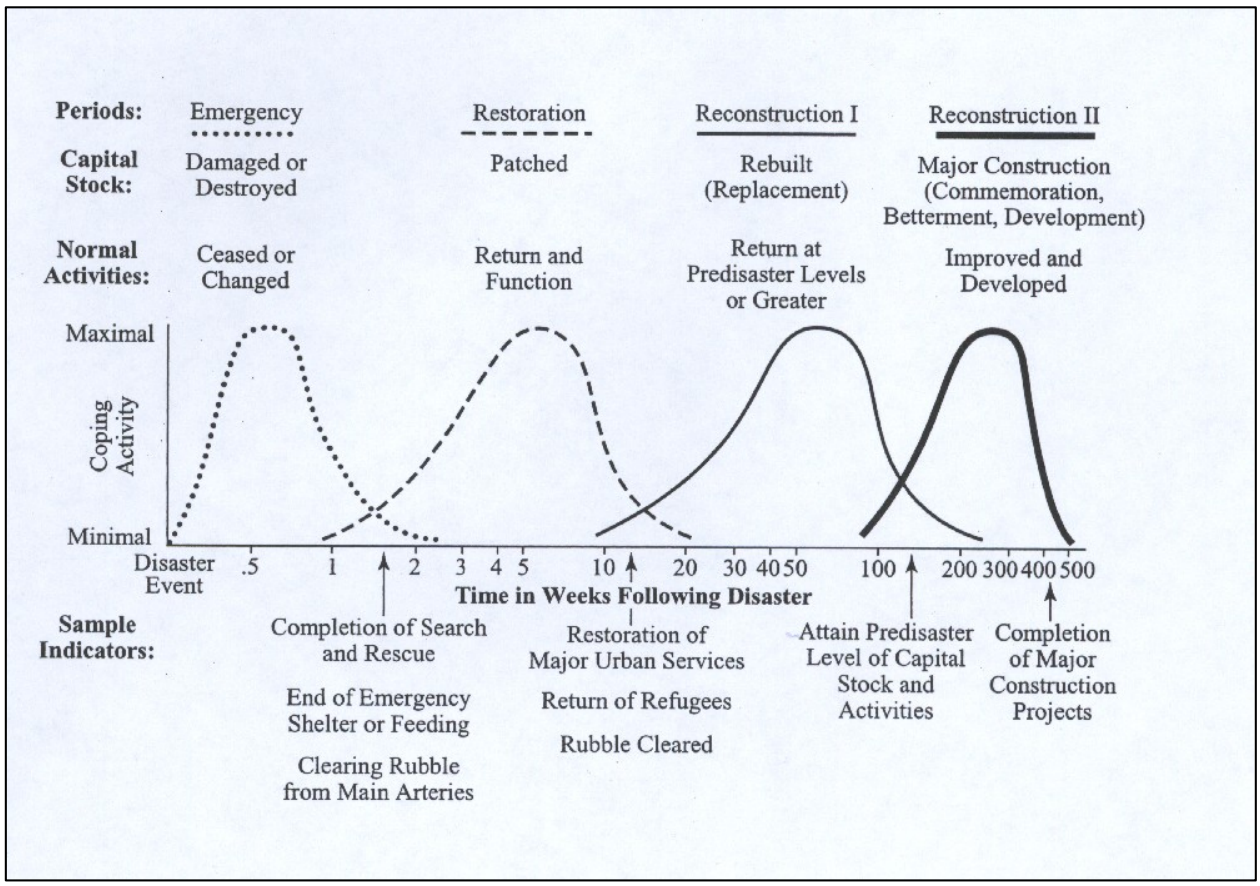

Figure 2 Model of Disaster Recovery (Redrawn by Vale and Campanella, 2005 from Haas et al, 1977)

These phases have been simplified into two phases by Schwab et al (1998):

a) Short term recovery- restoration of services but no major reconstruction works
b) Long-term recovery- returning community to conditions that existed prior to the event while taking opportunity to focus on mitigation measures

The time taken for a community to recover will vary according to the magnitude of damage and loss; however recovery will follow a similar pattern (Haas et al, 1977). However the model shown in Figure 2 shows the recovery as a whole and does not show uncompleted recovery which may occur in certain groups throughout a community as they may not be able to recover at the same rate as others. Therefore while recovery may follow this pattern of recovery the variations that occur during the recovery are of interest to see what causes and what changes these variations (Vale and Campanella, 2005).

Resilience and Vulnerability

Resilience is seen as contributing to sustainability and reducing vulnerability (Klein et al, 2003) therefore resilience to natural hazards is the ability of a person or group to cope with or adapt to stress caused by natural hazards (Blaikie et al, 1994). Other definitions of resilience note that the system will return to its original state (Klein et al, 2003) however this is not ideal for an urban environment at risk to natural hazards as the risk will always remain the same if it returns to its original state. Resilient and therefore sustainable communities are defined as societies which are organised to minimise the effects of disasters, and, at the same time have the ability to recover quickly by resorting the social and economic vitality of the community (Tobin, 1999). It seems that resilience may take time to acquire, depending on certain circumstances when a disaster occurs. As knowledge of disasters, planning and engineering techniques develop so will resilience. Therefore a city will develop resilience gradually over time. In this way resilience can be compared to urban regentrification as the vulnerable parts of a city are slowly renovated.

Vulnerability is defined by Blaikie et al (1994) as the characteristics of a person or group that affect their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard. Cross (2001) outlines that vulnerability is determined by physical and social exposure, disaster resilience, pre event mitigation or preparedness and post event response. Therefore reducing these vulnerabilities requires putting mechanisms in place combined with technology, expertise and other resources to complete the process of reducing vulnerability (Klein et al, 2003). Therefore resilience and vulnerability are closely connected.

Anticipatory action, or the ability to plan, prepare and implement adaptive options, can help to prevent vulnerabilities (Burton et al 1993; Mitchell 1993; Godschalk et al 1999; Pelling 2003 in Klein et al 2003) while resilience can be linked to planning and adapting to natural hazards (Dovers and Handmer, 1992 in Klein et al, 2003).

The terminology in use has many subtle variations, as each have a slightly different focus. This may depend on the agency using the terms and their overall aims. This may produce significant problems with interorganisational understanding.

Pre event planning

Disasters can produce major difficulties for local governments through failure in recovery leadership (Rubin, 1985 in Ying Wi and Lindell, 2004; Spangle Associates, 1997), impromptu decision making (Rubin 1995) and poor interdepartmental co ordination (Rolfe and Britton, 1995 in Ying Wi and Lindell, 2004). A great deal of planning is focused on the emergency response (Haas et al, 1977) however, pre event planning is critical to achieve successful coordination among agencies ensuring a smooth transition between response and recovery activities (MCDEM, 2005)

To reduce the problems that may often occur in a post disaster situation pre-event planning can be beneficial. Wilson (1991) argues that the preparation of pre-impact recovery plans provide locals officials with time to consider how the activities that take place during the immediate aftermath will affect long term recovery. Likewise, Geis (1996) and Haas et al (1977) propose that recovery issues resolved in advance, by means of disaster scenarios will increase the efficiency and quality of post-impact decision-making.

Essential Components of Pre event recovery plans

An efficient and effective recovery plan combines a number of elements which should work together to create a useable long term recovery plan (Rubin, 1985, in Ying Wi and Lindell, 2004). Personal leadership, the ability to act and knowledge of the actions to take are three necessary components of recovery. Wilson (1991) believes that recovery should be a continuing organisation wide process with the full support and involvement of top officials.

Schwab et al (1998) highlights four sets of decisions which are important to address when planning:

1) Sites for temporary housing, relocation of damaged businesses and dumping of debris
2) Closure of roads and bridges
3) Restoration or relocation of critical infrastructure
4) Reconstruction or relocation of dwelling units

Additionally the plan should also evaluate the roles and responsibilities in recovery, and the potential sources of financial help (Mileti, 1999). Schwab et al (1998) and Mileti (1999) believe that post-disaster recovery plans will be most effective if prepared in accordance with these principles:

- Consensus Building- avoiding conflict by involving the community in rebuilding decisions
- Providing Information- about the hazard, exposed population, buildings and infrastructure and the resources available for recovery aid
- Procedures – should stray as little as possible from pre disaster procedures
- Planning Style- should allow flexible and cooperative procedures to replace more formal rule orientated ones

Overall a pre-event plan creates a vision for decision makers and a framework within which decisions will be made with general guidance and principles to follow (Schwab et al 1998) as well as incorporating mitigation programs to further reduce risks (Comerio, 1998 in Ying Wi and Lindell, 2004).

Hazard Mitigation

In the immediate aftermath of a disaster is a timeframe know as a 'window of opportunity' (Burby, 2004; Kingdom, 1995 in Ying Wi and Lindell, 2004). This is the most appropriate time to make changes to improve resilience. However it is easy for these opportunities to be lost as decisions need to be made quickly, usually in an atmosphere of confusion and with pressure from governments and the public. Schwab et al (1998) believe that there is about a 1 month window of opportunity in which changes can be incorporated into plans. If decisions are rushed then vulnerability may be reproduced or hinder recovery (Schwab et al, 1998).This was the case in Sri Lanka after the Boxing Day tsunami where new land controls inhibited recovery and were later discarded (Ingram et al, 2006). Pre event planning means that the window of opportunity can be used to its fullest advantage of to its fullest as time is must not be wasted making decisions.

The best time to introduce hazard mitigation measures is during the window of opportunity. Hazard mitigation is the forward action that is taken to reduce or eliminate the long term risk to human life and property from natural hazards (Berke and Beatly, 1997; Godschalk et al., 1999 in Ying Wi and Lindell, 2004). Mitigation measures can be divided into 3 categories:

- Community Protection Works- dams, levees drainage systems that provide protection to a specific area
- Land Use Practices – zoning, planning to prevent development in hazardous areas
- Building- Construction Practices- structural designs and materials that increase the resilience of structures in hazardous areas

Recovery in a New Zealand Context

Disaster management in New Zealand is governed by the 4 R's concept, shown in Figure 3 (MCDEM, 2005). *Reduction* focuses on reducing risks of disasters, *readiness* concentrates on ensuring groups are prepared for the effects of a disaster, and *response* is planning for the initial response to a disaster and finally recovery focuses on restoring and improving the resilience of an affected community. Recovery in New Zealand from past events in New Zealand has often occurred haphazardly with the focus on restoring normal function as soon as possible (Becker et al, 2006).

There is a high likelihood of experiencing an extreme disaster of some sort in New Zealand in the future due to the dynamic nature of the geological setting. Therefore planning and risk reduction are important concepts to understand.

While pre-event planning is aimed at improving recovery, all of 4 R's impact and affect recovery. Disaster mitigation is a part of risk reduction and a key component of pre-event planning. In New Zealand there is specific legislation designed to lessen the effects of a disaster, the Civil Defence Emergency Management Act 2002, the Resource Management Act 1991 and the Building Act 2004.

The worst disaster to occur in New Zealand to date was the 1931 Napier earthquake. This disaster has the highest cost of lives and damage as it is the strongest earthquake

to effect a large population. As this area was severely damaged it is the best place in New Zealand to look at how Napier recovered from the disaster. Therefore Napier is used as a case study of recovery in a New Zealand setting to formulate a pre-event recovery plan template appropriate to New Zealand.

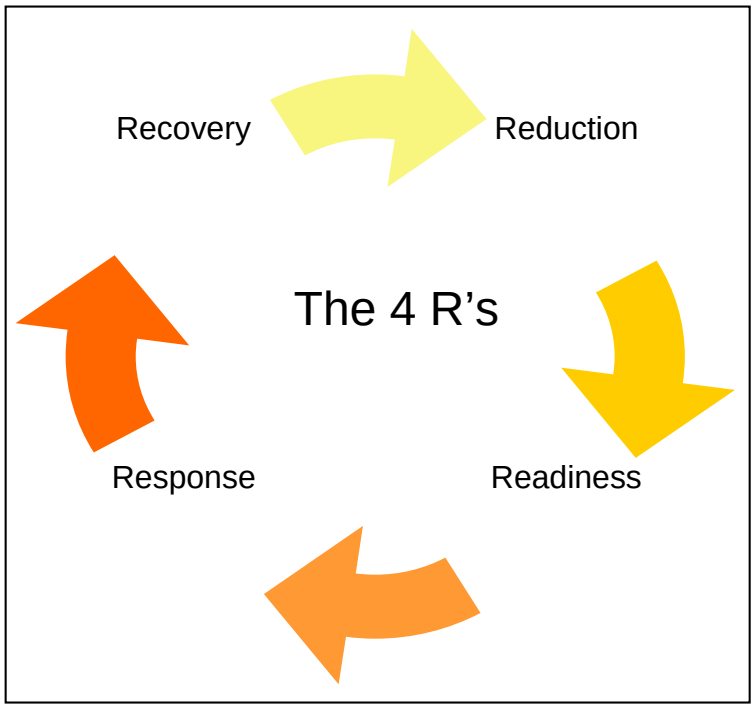

Figure 3 The 4 R's of Disaster Management (MCDEM, 2005)

Aim of Study

The aim of this study is to compare the recovery of Napier 1931 with examples of international recoveries to observe:

- Was the recovery of Napier in 1931 successful?
- Did recovery in 1931 improve resilience?
- Would recovery now be similar to what happened in 1931?

Using the case study of Napier a secondary aim is to study pre event recovery plans to see whether:

- Pre-event recovery plans are helpful during recovery and
- A recovery plan template could be constructed for a NZ setting.

Research Method

International case studies were analysed to compare their recoveries. The New Zealand case study was analysed to understand how the recovery occurred in a New Zealand situation, differences between 1931 and today were considered. These examples of recovery were synthesised into a recovery plan template.

International case studies

International case studies were studied to see how recovery was approached and what problems occurred: so the progress of recovery can be analysed.

Boxing Day Tsunami, 2004, Indian Ocean- This is used as a case study of recovery that is occurring presently and has been ongoing for the past two years; it allows different approaches to recovery to be observed through different countries affected. The tsunami was a relatively unexpected disaster to some countries such as Sri Lanka. There were no pre-event recovery plans prepared before the disaster, but a recovery plan was designed a few months after the tsunami.

Hurricane Katrina, 2005 Gulf States USA- This recovery is also ongoing presently but it is at a different stage from the tsunami recovery. This recovery is also happening in a developed country which has similar legislation and social structures to New Zealand compared to the countries involved in the tsunami. Hurricanes are a yearly event in the Gulf States of the US. However the State of Louisiana and particularly the city of New Orleans are unprepared for these disasters. The hurricane is an example of an unsuccessful recovery when compared to the other 2 examples.

Northridge Earthquake, 1994, California USA- This recovery was a success. It is also helpful to compare this disaster to Katrina, as both occurred in the same country. There are a few similarities between the two, but a major difference is the level of preparedness of the two regions. This disaster was different to the others studied as a recovery and reconstruction plan was prepared before the disaster occurred.

These disasters are relevant to New Zealand as there are similarities and major differences in the social and economic situations; they are also useful comparisons to

each other for the same reasons. These disasters have also shown the way in which reduction, readiness and response may improve or impair recovery.

New Zealand Case Study

Napier Earthquake 1931- The Napier earthquake was chosen as the case study as it is New Zealand's worst disaster. It caused the most damaged and claimed the most lives. There has not been such a large scale recovery since this event in New Zealand. However it is likely that an event of a similar scale could happen in any region of New Zealand from a number of processes.

Field Work

Fieldwork included a visit to Napier to conduct interviews and look at the recovery aspects of the town. This included information from the Art Deco Trust and Museum.

Interviews

Nigel Simpson- CDEM Coordinator- Nigel is the Civil Defence coordinator for the Hawke's Bay region. He was able to give information on likely scenarios for Napier and how Civil Defence is planning for recovery in this area. He also gave information on structure of a plan, and the important elements to communicate in the plan.

Claire Hatfield- Policy Analyst, Napier City Council- Claire gave information on how new policies or changes in current policies could best be incorporated into current council plans and how cost and time would affect this.

Elizabeth Lambert- Planning manager Hawke's Bay Regional Council – gave additional information about how hazards are planned for by the Regional Council (especially coastal hazards).

Tony McCleary, Tenancy Manager, Housing New Zealand – Tony outlined how welfare takes care of people after a major disaster. He discussed the options that are available for temporary accommodation for displaced people and the pros and cons of this kind of arrangement. State housing was also discussed.

Clive Squires – Recovery Manager, Hawke's Bay Civil Defence- Clive gave information on recovery plan details, on feasibility of some concepts.

Hawke's Bay Lifelines Group- Discussed how lifelines are prioritised and mitigation measures are incorporated, what groups are responsible for different lifelines repair, and the requirement for skilled workers from outside the effected area to repair lifelines which are highly technical.

James Mineham- Planner Napier City Council- James answered questions about how recovery would fit into the district plan, how re-zoning of areas would take place and other changes that might be undertaken during recovery.

Review of Legislation

The current legislation that relates specifically to natural hazards and disasters in New Zealand was examined to see how recovery planning could fit into these existing frameworks. Legislation reviewed:

- Civil Defence Emergency Management Act 2002,
- Resource Management Act 1991,
- Local government Act 2002,
- Building Act 2004, Historic Places Act 1993
- Local Government Official Information and Meetings Act 1987.

Recovery Templates and Interdependency Matrixes

Recovery planning templates were designed based on case studies, legislation and information obtained during interviews. Recovery templates were made using the Corel Draw 12 programme. They combine a pre-event plan with a post-event plan component.

Interdependency matrixes were developed for each environment to show which agencies are dependant on others. A relative scale of 1-5 was used basing dependency

on the amount of communication needed between agencies, with 1 being low level of communication and 5 being high level of communication.

Chapter 2 - International Case Studies

Introduction

Three international examples of recovery have been studied to isolate similarities and differences with the recovery of Napier in 1931. These examples are:

- Boxing Day Tsunami 2004- Sri Lanka and Indonesia
- Hurricane Katrina 2005- New Orleans
- Northridge Earthquake 1994- Los Angles area

These case studies have been chosen for specific reasons. Firstly, to construct a recovery template for an all-hazards recovery approach. Therefore, different types of disasters were chosen. Earthquakes and tsunami are likely to occur in most areas of New Zealand. While New Zealand is not at risk from hurricanes it is at risk from meteorological disasters such as extreme wind gusts, surface flooding, snowfall and cyclones.

Secondly, the Boxing Day Tsunami and Hurricane Katrina disasters are actively recovering at the time of writing. This gives the opportunity to see the problems which have occurred during the recovery, which in the case of these two disasters has occurred without pre-event recovery planning.

Lastly, the Northridge earthquake is an example of a successful recovery with a pre-event recovery plan. Two American disasters have been chosen to compare because their culture and systems are similar to New Zealand.

Indian Ocean Tsunami 2004

On the 26 of December 2004, a 'great' earthquake (magnitude 9) occurred off the western coast of Northern Sumatra. The earthquake lasted for approximately 8 minutes, during which time about 1 trillion tonnes of seawater was displaced causing a devastating tsunami (Ni et al. 2005, Lay et al. 2005 in Goff et al. 2006). The tsunami reached Sumatra a mere 15 minutes after the earthquake and continued to travel across the Bay of Bengal, Andaman Sea and Indian Ocean, reaching the shores of East Africa 7 hours later (Goff et al, 2006).

As a result of the tsunami, 285,000 people lost their lives, with countless others injured. The tsunami destroyed 400,000 homes. Other lifeline infrastructure was severely damaged including many coastal roads and railways. At least 1.4 million people lost their livelihoods, the majority of whom relied in some way on the fishing industry (United Nations, 2005; Oxfam International, 2006b).

In addition to the 26 December earthquake and tsunami, another earthquake and tsunami occurred months later on the 28 March 2005. This time the damage was concentrated mainly on the coast of Nias, Sumatra. This tsunami left a further 1,000 people dead and 70,000 displaced (United Nations, 2005; Oxfam International, 2006b).

Unlike the Pacific Ocean, the Indian Ocean does not have a tsunami-warning centre. The earthquake that caused the tsunami was so great that it was not immediately known how big it was as the seismic instruments are not designed for such events. When it was known that the earthquake was large enough to have the potential to cause a tsunami it had already struck in some places, and the places it was heading for did not have the communication lines or plans in place to get messages out to people.

The 2004 Asian Tsunami has been chosen as a case study for this study as the recovery phase is occurring currently. In addition, this disaster was underestimated in that an earthquake and tsunami of the size that occurred was completely unexpected. There was no planning for this event, as it was not considered as a likely disaster. The

worst effects areas were the region of Bandah Aceh, Indonesia, and the coastal areas of Sri Lanka and Thailand. Although affected, India declined foreign aid and indeed gave aid to Sri Lanka (FAO United Nations, 2005).

Effects of the tsunami

Sri Lanka

The tsunami struck the shores of Sri Lanka 2 hours after the earthquake with the second wave the biggest (James Lee Witt Associates, 2005). The largest tsunami wave height of 8.71m was recorded at Nonagama, while the greatest inundation distance of 390m and run up height of 12.50m occurred at Yala (Goff et al. 2006).

Most Sri Lankans live on a narrow coastal plain less than 30m above sea level. Coastal features determined to an extent the damage suffered by the tsunami. The headlands blocked the tsunami inundation while the sandy bays focused the waves, which increased run up and inundation (Goff et al. 2006).

Sri Lanka is situated in an intra plate setting and experiences little seismic action, therefore it is perceived that the country is not at a great risk from earthquakes and tsunamis. The most frequent natural hazards in Sri Lanka are cyclones. The first sign of the tsunami in Sri Lanka was a negative wave, where the water receded at least 1 km in some places. This was then followed by two large positive waves (Goff et al, 2006).

The government struggled to respond effectively, having no formal incident command system. Within 3 days a Centre for National Operations was established under direct control from the prime minister to coordinate national and international relief operations (Yamada et al, 2006).

Aid services were inundated with supplies from overseas. This caused a major problem for two reasons. There was very little in the way of warehousing and storage facilities to store the donation materials. This led to piles of donated clothing and other items being dumped in villages and temporary camps. Most of the donated items were completely unsuitable for a tropical environment. Directly after the tsunami

many displaced people were given tents, which were unbearable in the hot humid conditions and start to rot after a few days (Yamada et al, 2006). Many people donated clothing such as woollen jerseys and heavy winter jackets, which were not suitable for the climate. In addition, much of the clothing was inappropriate for the culture and religious beliefs of the area.

The military assisted in the emergency phase by rescuing and transporting people, clearing debris and helping to restore vital services. Injured people were firstly transported to hospitals by helicopter. Ambulances from inland parts of Sri Lanka were sent to help transport people to hospitals further away from affected areas, as coastal hospitals were overwhelmed with injured.

In Sri Lanka, deaths which occur outside the hospital require the bodies to be brought to the hospital for autopsies and forensic tests (Yamada et al, 2006). Hospital morgues usually have the capacity to deal with 5- 10 bodies at any time. Staff and patients left some hospitals as they became completely inundated with bodies. Identification of the deceased was extremely difficult as rapid decomposition occurred from bodies being in the water for long periods. Some bodies were finger printed and photographed, however it was impossible for this to be done for all. DNA Identification testing was not available so many bodies were buried in mass graves (Lessig et al, 2006).

Language differences caused problems between international aid workers and locals. Only educated people in Sir Lanka speak English, most people affected by the tsunami did not speak English. Cultural differences were also significant, in addition to a lack of coordination between Non Government Organisations (NGO) and Sri Lankan health providers. This included duplication of some services and often a lack of records resulting in people receiving multiple or unnecessary vaccinations.

Housing

The tsunami destroyed or damaged 98,000 houses in Sri Lanka, which left 516,159 people without homes (United Nations, 2005). Transitional shelters have been built by NGOs, the government and donor agencies under Task Force Relief to house the displaced population during rebuilding. Sri Lanka must now rebuild 100,000 houses. Approximately 65 percent of the houses are under construction and at least 5 percent

are finished. Three major factors are slowing the reconstruction of housing in Sri Lanka: 1) property issues, 2) lack of materials and skills and 3) Civil unrest (United Nations, 2005; Oxfam International, 2006a).

Days after the tsunami the Sri Lankan government implemented a policy which prevented people rebuilding within 32-200m of the ocean; 32,000 of the damaged houses fall within this coastal buffer zone (Ingram et al, 2006). Many people who depend on the ocean for their livelihoods are in temporary housing camps long distances from the ocean. A significant number of these people lived in poverty with poorly constructed housing and without land titles. Those who did have land titles or may now be able to inherit property may no longer have any documentation to prove ownership rights. Those who are at particular risk of losing property from lack of documentation are widows and women. However, the government has now decided to rethink this buffer zone policy and at the time of writing a final decision has yet to be made (United Nations, 2005; Oxfam International, 2006a).

Other issues with housing are the disparities between housing built by different NGOs (United Nations, 2005; Oxfam International, 2006a). This often leads to feelings of inequality amongst villages, and some areas are being rebuilt lacking infrastructure such as sanitation and road access. However, this is also a result of unclear building policies and often a lack of adherence to pre-disaster building regulations. In addition, there has been a lack of consultation with local villagers about reconstruction plans. These factors, and others, have led to a resurgence of activity by the Liberation Tigers of Tamil Eelam (LTTE) mainly in the north and east. This has slowed reconstruction even further by displacing tsunami victims in the LTTE controlled areas due to violence and lack of supplies allowed in or out of these areas. Shells have hit some rebuilt houses during the conflict.

The other problem with rebuilding is getting resources and labour to build so many desperately needed homes. Care needs to be taken that resources are not taken to rebuild at a cost to the environment. Resources such as sand for concrete, timber for construction and additional building materials are hard to acquire (Ingram et al, 2006). It is important to make sure that any timber that is used in reconstruction has come from a sustainable forestry practice. These problems have led to many of the materials

being imported. However, a shortage of warehouse and storage facilities and accessibility to damaged areas is still a problem adding delays to construction. Skilled labour is also a problem. Some people who have lost their livelihoods have begun to build as an alternative source of income; however some are poorly (if at all) trained leading to some construction work of poor quality (Ingram et al, 2006).

The sheer scale of the reconstruction needed to all areas of the community is extremely daunting to a country with no formal emergency management structures in place.

Livelihoods

Approximately 150,000 Sri Lankans lost their source of income in the few minutes it took for the tsunami to occur (United Nations, 2006). Fifty percent of these people were involved in the fishing industry, four to five percent in the agriculture industry, and the remaining forty five percent were in tourism, small business, the public sector or self-employment.

Since the tsunami, many NGOs have donated fishing boats and nets to fishermen who lost their equipment. However, this has led to problems. Directly after the tsunami a fear of the ocean and a reluctance to catch and eat fish because of the belief that they may have been feeding on corpses prevented a speedy re-establishment of the fishing industry (Yamada et al, 2006). A lack of consultation between fishermen and NGOs meant that fishermen who needed boats that could stay at sea for weeks received boats that were only suitable for day fishing (Yamada et al, 2006; United Nations, 2006).

A ‘culture of dependency’ arose in some of the temporary camps. After receiving a monthly stipend of 5000 rupees and basic rations of rice, dhal, sugar and coconut milk many people came to expect this aid and were not motivated to recover their own livelihoods (Yamada et al, 2006). Cash for work schemes were often poorly attended and in some camps fisherman refused to return to the ocean. Some fishermen have begun to act as middlemen contracting other men to catch fish for them with the boats and nets they received from NGOs and they take a large proportion of the fish caught.

People living in rural coastal areas are particularly vulnerable as they rely heavily on natural resources to generate income (Pomeroy et al, 2006). To try to reduce some of that vulnerability NGOs are trying to encourage more diversity in livelihoods. This includes catching different fish species, or growing a variety of plants. This also depends on the diversity of the families' income. Therefore, employment opportunities for women have become increasingly important in the post tsunami environment. These jobs include craft making, basket weaving and sewing, agricultural work or fish processing (Yamada et al, 2006; Oxfam International, 2006b).

Social and Community Recovery

In Sri Lanka there has been a noticeable lack of communication between government departments, local people and NGOs, especially concerning land use policies and property rights. This has led to recovery of homes and villages being slow and patchy. Recovery of livelihoods has made progress, however there are still many people living in temporary camps.

Services such as health and education were severely affected by the tsunami (Yamada et al, 2006, United Nations, 2006, Oxfam International, 2006a; Oxfam International, 2006b; Ingram et al, 2006, Fritz Institute, 2005). Nearly 100 health centres and hospitals were destroyed and 182 schools were destroyed or damaged. Reconstruction of these facilities is under way, with temporary services being set up in temporary camps. The government has an agreement with 30 major international donors to rebuild all damaged schools. Psychological services have been set up in these temporary schools to help children and the return to school of children is 95 percent. Medical schools are training graduates in counselling services and sending them out to affected areas to provide support. There has been a severe increase in substance abuse in many villages since the tsunami as a consequence of the traumatic experience.

Environmental Recovery

A major environmental problem is how to deal with the debris from the tsunami. Debris was carried hundreds of metres inland by the waves. This debris includes boats, trucks, cars, trees and a variety building materials (Ingram et al, 2006). The beaches in areas were cleared within a few days of the tsunami, however in many

cases the debris was left piled inland away from beaches or dumped in drains. Much of the debris was deposited on agricultural land, which is now unusable. The other waste management problem is the amount of plastic material used during the relief and recovery phase. Careful planning is required for the management of this waste and other waste generated during the recovery process (Shaw, 2006).

Water logging of agricultural land is also a significant problem. Areas of agricultural land will take months to recover from ponding of salt water (FAO United Nations, 2005). Many of the fruit trees grown in these areas will take another 4 or 5 years before they will bear fruit. Some areas are becoming water logged at high tide when they did not before the tsunami as a result of subsidence of the land

Many coastal environmental problems do not have quick or easy solutions (Oxfam International, 2006b). It is clear that natural coastal barriers such as sand dunes, coral reefs and mangroves protected many areas from the worst of the tsunami. The beach systems need to be rehabilitated to provide ongoing protection from the ocean, particularly the parts of Sri Lanka that had coastal erosion problems before the tsunami. NGOs have taken measures to help protect the beaches by replanting mangroves and constructing sand dunes, some of which had been lowered to give hotels better views

Indonesia

The tsunami arrived in the Indonesian province of Aceh 15 minutes after the earthquake (United Nations, 2005). As of April 2005, 128,715 were confirmed dead with thousands still missing. The damage is estimated at approximately $4.5 billion, which is nearly equal to the regions gross domestic product (GDP) (James Lee Witt Associates, 2005; United Nations, 2005). As Indonesia is close to the epicentre, many buildings were severely damaged by the earthquake as shown below in Figure 4. People were helping those hurt by the earthquake when the tsunami struck. In the aftermath, engineers and doctors volunteered their services and unaffected Indonesians donated money for food, water and shelter. The Indonesian Government introduced its official Reconstruction plan in March 2005 (James Lee Witt Associates, 2005).

Figure 4 Destruction in residential Banda Aceh from the 2004 Boxing Day Tsunami (Steinbeck, 2007)

Housing

The major problem with rebuilding housing in the province of Aceh is conflict over property rights (Oxfam International, 2006b). Three kinds of law regarding property rights are prevalent in Aceh. These are Adat - the local and traditional laws and social codes and the state laws passed by the Indonesian government. Aceh is an Islamic province so the Islamic law Shari'a applies to inheritance and guardianship matters. Seventy five percent of land ownership in Aceh is under Adat law.

The tsunami left 600,000 people homeless and over 141,000 houses destroyed. At this time (end of 2006), 48,000 houses have been rebuilt. Recovery has slowed because of contested land rights (Oxfam International, 2006b). Trees, fences or other landmarks marking the boundaries of properties have been wiped out by the waves. Local officials have conducted meetings with locals and created maps with new boundaries. The officials and local people sign the map to say it is correct. Then the land is surveyed and land titles drawn up (James Lee Witt Associates, 2005).

As many as 2,500 people need to be relocated to new land as their land either has been submerged or is unsafe(Oxfam International, 2006; Steinbeck, 2007). The

Rehabilitation and Reconstruction Agency for Aceh and Nias (BRR) is purchasing new land for these people; so far $7.7 million has been spent on 700 hectares of land. This process is slow as it can take up to six months to buy land in Indonesia. Then, because of the high water table, the land needs to be prepared for building. This process adds time and money to relocating people.

Inheritance claims under local and Islamic law have also lengthened the reconstruction process. People have been afraid to start rebuilding when they are uncertain of ownership of the land. These laws allow women and orphans to inherit property and measures are being taken to ensure that they are not overlooked during inheritance claim processes (James Lee Witt Associates, 2005).

Livelihoods

Many NGOs have facilitated training programs for displaced people who have lost their livelihoods. These training programmes are also important ways of diversifying income so that people's livelihoods are more sustainable. Skills that have been taught range from building and construction work to help with the shortage of skilled workers for rebuilding, to handicraft and sewing, rubber nursery and cocoa cultivation skills, to cake making. This addresses both men and women's needs, as many women are now the heads of households (James Lee Witt Associates, 2005; Oxfam International, 2006).

New docking facilities have been built to allow safe entry and exit to the ocean. The docks also provide places to buy and sell fish, cocoa and other commodities. As in other areas where fishermen have been affected by loss of equipment, NGOs have replaced boats and nets so fishermen may start earning again (Oxfam International, 2006a).

For those still unemployed cash for work, schemes have been implemented and employed 120,000 people. Two thirds of farmers have returned to their farms. Businesses are restarting through grants or microfinance (Oxfam International, 2006a).

Social and Community Recovery

Schools were severely damaged by the tsunami. Twenty-eight schools have been rebuilt with another 14 nearing the stages of completion (Oxfam International, 2006). Approximately 2000 teachers were killed by the tsunami so there has been a huge effort to retrain staff). Training has been completed by at least 111 teachers, with 28 teachers (one for each open school) trained in trauma counselling to help children having trouble dealing with the effects of the tsunami(United Nations, 2005, Oxfam International, 2006a).

New policies have been developed to regulate and standardise housing, resettlement and social assistance (Oxfam International, 2006). New community centres have been rebuilt along with reconstruction of essential services. Roads and bridges have been repaired to a better standard than before the tsunami .Most main highways are fully repaired however, secondary arterials roads now need to be repaired. Water storage filtration and delivery systems have been put in place to ensure all people have access to clear water (United Nations, 2005)

During the tsunami, 122 hospitals and health centres were damaged or destroyed. Thirty-eight of these care facilities are now fully functioning and a further 51 are under construction. Many health workers were also killed by the tsunami so there has been retraining of 2,500 people to staff these new centres (United Nations, 2005).

People in each village are getting to have input into the recovery process, which is important for the community dynamic. This has changed greatly after the tsunami as more women that men died. Social networks have been disrupted as some community leaders died in the tsunami. Community consultation in the recovery process helps to repair social networks (Fritz Institute, 2005).

Environmental Recovery

Some debris from the tsunami has been recycled for used in new buildings to try to alleviate some of the strain on construction materials (Oxfam International, 2006b). Remediation of farmland effected by saltwater and mud from the tsunami is occurring. Green Coast, a program working in partnership with Wetlands International is working to rehabilitate coastal ecosystems. Over 600 hectares will be

rehabilitated with coastal vegetation including mangrove swamps. Rehabilitation of 40 hectares of coral reefs has already begun.

Hurricane Katrina

Background

The Atlantic Hurricane season begins on 1 June and typically lasts until the end of November each year. Hurricanes form over warm oceans (>26 °C), the warm water heats the air and causes an area of low pressure to form. As the hurricane grows, it will develop stronger and stronger winds while the pressure continues to decrease. Since hurricanes rely on warm ocean water for strength a hurricane will weaken over land or cooler water. Storm surge, often the most dangerous factor of a hurricane develops due to the drag (friction) of the strong winds on the ocean water and the bathymetry of the coastline, causing a sudden rise in sea level (Simpson (Ed), 2003). Hurricanes are measured on the Saffir Simpson Scale shown in Table 1, with a category 1 hurricane being the weakest.

Table 1 Saffir Simpson Scale (Elsner and Kara, 1999)

Category	Damage	Pressure (mb)	Maximum Sustained wind speed (m s^{-1})	Peak Wind Gusts (m s^{-1})	Storm Surge (m)
1	Minimal	> 980	33-42	41-53	1
2	Moderate	980-965	42-50	53-62	2
3	Extensive	964-945	50-58	62-72	3
4	Extreme	944-920	58-69	72-86	4-5
5	Catastrophic	<920	>69	> 86	>5

The Gulf coast is particularly vulnerable to hurricanes; each summer the water warms enough for hurricanes to develop. Over the last 30 years, there has been considerable development along this area of coastline. Located in this area are important economic industries such as oil exploration, involving infrastructure for exporting resources. As a result of development, natural coastal barriers such as wetlands are disappearing at a rate of 25,000 acres per year; since it is estimated that 2.7 miles of wetlands can hold back 1 foot of storm surge, this represents a significant increase in vulnerability.

Sieur de Bienville, a French-Canadian noble man who believed the Mississppi River was in need of an ocean port, founded New Orleans in 1718. He chose the site of the current city on a curve of the river about 10 feet above sea level. The city was named after Philippe II the Duke of Orleans. When the site flooded in 1718 levees started to be constructed to prevent flooding. From then onwards till the present day the levees have been breached and repaired a number of times. In 1849 a levee was breached and floodwater stayed in the town for 6 weeks. Flooding in 1927 caused city officials to blow up the Caernarvon levee, which flooded a poor black neighbour to 'save' the rest of the city. In Hurricane Katrina 2005, the "fifty year" levees (which were the result of piecemeal repair jobs, outdated engineering and suspect construction techniques) failed, flooding 80% of New Orleans (Campanella, 2007).

Figure 5 New Orleans showing levees and breaches during Hurricane Katrina, 2005 (http://news.bbc.co.uk/2/hi/americas/4217212stm, 2005)

The city is protected from flooding by a series of levees along Lake Pontchartrain and the Mississippi River as shown in Figure 5. The Army Corps of Engineers has been constructing the levees since the 1800s. However, the area on which New Orleans is situated is slowly sinking, so a large proportion of the city is below sea level, creating a bowl effect. The levees stop water flowing into the city; however if the city becomes flooded the water will not drain away and needs to be pumped out (Campanella, 2002).

New Orleans has experienced three close calls in the last century from Hurricanes. Hurricane Camille in 1969 made landfall as a Category 5 storm killing 225 people and injuring 8,900.

The Event

National Oceanic and Atmospheric Administration (NOAA) predicted the hurricane season of 2005 to be an active season with projections for 12 – 15 storms with 7-9 becoming hurricanes. By August, this projection had been revised with additional 11-14 storms, 7-9 of those becoming hurricanes, including 3-5 major hurricanes.

August 23: Tropical Depression 12 formed over the Bahamas.

August 24: the depression had strengthened to a tropical storm and was named Katrina.

August 25: Tropical Storm Katrina was upgraded to a Category 1 Hurricane on August 25(Department of Homeland Security, 2006). At 6:30 pm Katrina made landfall in South Florida with sustained winds of 80 mph. Twelve people were killed and at least $ 2 billion in damage caused by the hurricane. The Gulf States began hurricane preparations. Katrina was predicted by the National Weather Service (NWS) to make landfall on North Gulf States. Emergency Operations Centres were activated. Federal Emergency Management Association (FEMA) pre-staged 400 truckloads of ice, 500 truckloads of water and 200 truckloads of food at logistic centres in Alabama, Louisiana, Georgia, Texas and South Carolina. FEMA also placed Emergency Response Teams on alert.

August 26: Katrina moved west of the gulf and strengthened to a Category 2 hurricane on August 26(Department of Homeland Security, 2006). The National Hurricane Centre (NHC) released a tracking forecast projecting the eye of the storm would pass over New Orleans on August 29 as a Category 4 or 5 hurricane with a possible storm surge of 15-20 feet. The state Governors of Louisiana and Mississippi declared a state of emergency and put response plans into action. Emergency Operation Centres were put on the highest level of alert.

August 27: On August 27, Katrina strengthened again, this time to a Category 3 hurricane and almost doubled in size (Department of Homeland Security., 2006). Louisiana began implementing Phase 1 of the Louisiana Emergency Evacuation Plan

including contra flow plans on major highways. Four churches in the area were involved in the pilot scheme 'Operation Brothers Keepers' which helped evacuate people without their own transport. It was estimated that at least 100,000 people in New Orleans did not have their own transport, posing an evacuation problem.

New Orleans declared a state of emergency, and advised residents to voluntarily evacuate and store up on non-perishable food and bottled water.
FEMA moved to the highest alert level and continued to pre- stage supplies.

August 28: President Bush declared states of emergency in Mississippi, Louisiana and Alabama on August 28 (Department of Homeland Security, 2006). This action authorized federal spending to assist the state and local governments in making provisions to save lives and property.

Katrina strengthened to a Category 5 Hurricane. The NHC advised that the levees in New Orleans could be overtopped by Katrina's storm surge. They also noted that if these conditions occurred, New Orleans would be uninhabitable for weeks, with extreme water shortages. Weather warnings and forecasts increased. Mississippi and Alabama ordered evacuations of low-lying areas; President Bush ordered mandatory evacuations of New Orleans.

At 5 pm contra flow evacuation was stopped and at 6:43 pm the airport was closed due to high winds (Department of Homeland Security, 2006; Brinkley, 2006). The Governor of Louisiana, Kathleen Blanco estimated that 92% of the population of New Orleans had been evacuated. The Superdome was opened as a shelter of last resort for general population with estimates of 10,000-12,000 people seeking shelter there. A request of 18,000 litres of water and 109,440 ready to eat meals was made to FEMA for the Superdome, however because of bad weather conditions only 90,000 litres of water and 43,776 ready to eat meals were supplied

The Louisiana National Guard supplied 10,000 ready to eat meals and 13,000 bottles of water to the Superdome. There were also law enforcement officers and 71 medical personnel situated in the Superdome to help people seeking shelter there. By sun

down on August 28 throughout the region there were pre-staged over 3.7 million litres of water, 4.6 million pounds of ice, 1.86 million ready to eat meals, in addition to another 2.1 million ready to eat meals located at nearby emergency operation centres (Department of Homeland Security, 2006).

On the evening of the 28th rain began to fall with high winds and hail.

August 29: Hurricane Katrina Makes Landfall

Hurricane Katrina made landfall as a Category 3 hurricane at 6:10 am August 29 in Plaquemine Parish, Louisiana (see Figure 6).

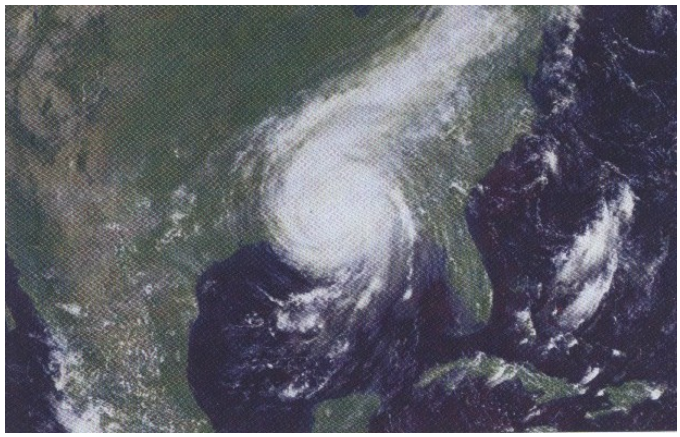

Figure 6 Satellite Image of Hurricane Katrina as a Category 3 storm making landfall, Monday 29 August (Brinkley, 2006)

It continued to move north with sustained winds of 115 mph and gusts of up to 130 mph. By 1:00 pm, Katrina was downgraded to a Category 1 hurricane. Reports of storm surge were estimated to be at least 27 feet in Louisiana (Department of Homeland Security, 2006; Natural Hazards Centre, 2006).

The Response

At 9:12am August 29 NWS reported that the levees of New Orleans had been breached. However, because all lines of communication were down reports varied and people interchanged overtopped and breached, adding to the confusion. Homeland Security reported at 6:00 pm August 29 that pending an assessment no levees had

been breached. At this stage, 80% of New Orleans was flooded to height of 20 feet (Department of Homeland Security., 2006; Brinkley, 2006).

The Mayor of New Orleans, Ray Nagin, took shelter in a New Orleans hotel, however the hotel lost all communications and he was trapped there for 2 days without being able to give any orders regarding response and rescue (Department of Homeland Security, 2006).

August 30: Conditions in New Orleans continued to worsen because of the flooding, this sparked officials to organise a mass evacuation of the city. However, there was no post-landfall evacuation plan, so state and local government officials worked closely with the Department of Defence and the Department of Transportation through FEMA to conduct evacuations (Department of Homeland Security, 2006). Some people rescued from their homes were left on dry roads for days until evacuated as shown in

Figure 7.

Figure 7 Survivors of Katrina stranded on an elevated section of Interstate 10 on August 31st (Brinkley, 2006)

During this time, many police officers abandoned their positions, two police officers committed suicide. Approximately 133 New Orleans Police officers either resigned or were let go as a result of Hurricane Katrina. People began looting mainly for food

and water; nevertheless there are reports of people taking electronic equipment. However some of these stories are unfounded (Department of Homeland Security, 2006; Brinkley, 2006; Natural Hazards Centre, 2006).

People who were not at the Superdome began to make their way there or to the convention centre. The latter was not designated as a shelter and no supplies had been pre-staged there, however people presumed that a large public building on high ground would be a shelter (Department of Homeland Security, 2006).

Many deaths occurred as a result of Katrina, many of these people were elderly and sick. Reports of hospitals and rest homes full of decaying corpses are common. The majority of these people died as a result of extreme dehydration. Others drowned as the levees burst, as most facilities were completely empty the corpses stayed where they were. Bodies found floating in the flood waters were tied to structures until there were the facilities to be able to deal with them (Department of Homeland Security, 2006; Brinkley, 2006; Natural Hazards Centre, 2006).

The Army Corps of Engineers spent 53 days pumping approximately 250 billion gallons of water from New Orleans (Federal Coordinator for Gulf Coast Rebuilding, 2006; Department of Homeland Security, 2006; Brinkley, 2006; Natural Hazards Centre, 2006).

The Recovery

Six Months After

Housing

- Six months after the hurricane recovery in the region had begun. Meeting long term housing needs for displaced people has proved a major challenge. All housing recovery is coordinated by the U.S Department of Housing and Urban Development (HUD) (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006a).

- 18 months of housing assistance has been administered by HUD to 15,000 HUD assisted or homeless families. HUD is repairing 6,000 of its damaged homes in the disaster area, and 1,000 people have already moved back in. Once repaired, the remainder of these houses will be offered to displaced people as temporary shelter or for purchase at a discounted price.

- HUD has begun a Mortgage Assistance Initiative for people unable to pay mortgage repayments due to damage or repairs and loss of income caused by Hurricane Katrina

- The Universities Rebuilding America Partnership program has been initiated by HUD. This involves getting skilled university students to help rebuild devastated communities.

- Measures are being taken by other governmental agencies to ensure that housing is allocated to those in need with out discrimination.

Economy

- The US Department of Agriculture (USDA) is assisting rural families with funds to repair and rebuild damaged buildings. USDA is making $1.2 billion available for emergency assistance for farmers (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006a).

- The Department of Commerce (DOC) has created the Hurricane Contracting Information Centre that will provide a point of reference for minority- or women-owned businesses to register for Federal contracting opportunities. DOC is also helping rebuild businesses including technical assistance, development of long-term recovery strategies and business counselling services.

- Emergency grants of $2.3 million have been awarded through the U.S Department of Labour (DOL) across 11 states to help people whose source of income was impacted from the hurricane. The DOL has allocated $12 million

to train workers for jobs in critical industries such as, construction, energy, health care, transportation and safety/ security

- On December 21, 2005, the President finalised a law change, the Gulf Opportunity Zone Act. The purpose of this Act is to kick start the Gulf's economy, by increasing business expensing including demolition and clean up and accelerating bonus depreciation.
- The Internal Revenue Service has authorized certain extensions for tax returns and paying taxes, and other tax related activities for people affected by Katrina

- Oil production in the Gulf of Mexico is running at 76% of pre-Katrina production while gas production has been restored to 85% of pre-Katrina production. Repair of oil pipelines has been ongoing.

Environment and Levees

- NOAA has collected 10,000 digital aerial photos for damage assessments and oil spill response prioritisation (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006a). They have assisted in cleaning up over 8 million gallons of spilled oil in the Gulf of Mexico. Their navigation Response Team, have been surveying the waterways looking for large debris, sunken ships and shoaling to ensure shipping lanes can be kept open and safe

Community and Social

- Repairs from the Department of Transportation (DOT) have reinstated basic transportation services, 44% of Louisiana's highways have been repaired while 91% of Mississippi highways have been restored (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006a).

- In New Orleans 13 bus routes have been restored. The Port of New Orleans is running at 100% of its pre- Katrina activity even though only 70% of facilities are operational and 85% of workers have returned. Gulfport (the worst hit port) is running at 50% of its pre-Katrina activity

- Energy companies have worked together to provide power to devastated areas and have discussed incorporating new technologies into the power system especially in New Orleans.

- The Department of Health and Human Services (HHS) has allocated $550 million for support to those without health insurance or adequate access to healthcare, and for health care providers. One floor of the Veterans Association nursing home has been reopened and there are temporary mobile clinics operating in the affected areas.

One Year After

Housing

- One of HUD housing programs is Community Development Block Grants (CDBG), which is to help people rebuild damaged housing and infrastructure. As of August 9, 2006, over 100,000 homeowners have applied for assistance ((Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006b); Department of Homeland Security, 2006; Allen, 2007)

- Grants of up to $150,000 dollars are being given to residents whose houses were located outside pre-Katrina flood zones. Additional grants of $30,000 are available to help with costs of elevating houses to new hurricane safe building codes.

- Mortgage relief foreclosure was extended to allow mortgagers to rebuild homes or preserve good credit by paying of mortgage.

- FEMA and HUD have worked together to provide HUD houses which were previously off the housing market to be available for lease by displaced people. So far, 10,000 homes have been leased

- The Housing Authority of New Orleans (HANO), which has been under HUD receivership since 2002, has organised 2,000 of its 7,000 housing units that were not damaged for lease by hurricane victims. HUD has also set up a

Disaster Voucher Program, which is aimed at helping people make the transition from FEMA housing to more semi- permanent or permanent housing

- HUD has had to monitor rent prices in Louisiana through its Fair Rents Market. In New Orleans HUD has increased its Fair Markets Rents by 35%

- Still ongoing is the Universities Rebuilding America Program, this program has been made possible with a partnership between HUD and the Corporation for National and Community Service

- Home Depot and HUD have staged workshops for hurricane victims. The aim of these workshops is to increase hurricane preparedness and give advice on repairing houses.

Economy

- At this time, all ports are open with no restrictions. The Coast Guard are playing a major role in the recovery of shipping in the Gulf of Mexico (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006b).

- All petroleum refineries and crude and petroleum product pipelines affected by Katrina are back to normal operations.

- The U.S Department of Agriculture (USDA) have set up special grants to help hurricane-affected farmers. This includes grants for increased feed costs for livestock, reimbursement for deceased stock, non-insured crop payments, debris clean up and replanting trees.

- Other USDA programs included debris removal from farmland and nurseries, levelling land, replacing fencing and rebuilding farm structures such as chicken houses

- Over $10.3 billion, worth of disaster loans has been approved by the Small business administration for homeowners, renters and business owners affected by Katrina.

- The U.S Department of Labour (DOL) has invested in four initiatives in the Gulf Coast region: National Emergency Grants ($195 million), Community-Based Job Training Grants ($37 million), High Growth Job Training Initiative Grants ($12 million) and Pathways to Construction Employment Initiative Grants ($10 million).

Environment and Levees

- The NOAA has also helped in the recovery of the shipping industry by surveying shipping lanes for debris (sunken vessels, oilrigs and large debris) (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006b).

- FEMA has funded the removal of 100 million cubic yards of debris. At this stage, only 72% of debris removal in Louisiana is complete

- The U.S Army Corps of Engineers have repaired 220 miles of floodwalls and levees since September 2005. The New Orleans hurricane protection system is in equal or better condition than its pre Katrina condition

- The Army Corps is developing a plan to protect New Orleans from a Category 5 hurricane by increasing the strength of the levee and flood wall system by changing the design of the walls and increasing the interior drainage capacity.

- In several places, the levees have been armoured to protect against erosion, and pumping stations are being storm proofed.

Social and Community

- The rebuilding of public infrastructure such as schools, roads, water facilities and public buildings will be funded through a $5.5 billion grant from FEMA(Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006b).

- The U.S Department of Transportation (DOT) has allocated $2 billion dollars to repair and rebuild highway and bridges through the affect states. Additionally DOT is spending $62.2 million to rebuild airport infrastructure in Mississippi and Louisiana.

- In Louisiana, power has been restored to all customers who can receive power safely. However, in New Orleans the Lower Ninth Ward and Lakeview are still without power.

- The National Emergency Grants are being used to train and find jobs for 20,000 workers. The Pathways to Construction program focuses on encouraging people to pave a career in construction

- Federal services have been restored to affected regions including law enforcement and support for the space shuttle program (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2006b)

- Every hurricane-affected community has re opened at least one school. The Department of Education (ED) has made available $2 billion dollars to reopen schools, recover student records, replace lost materials and equipment, rent space for temporary school sites and helping to transport homeless students to school. All major universities and polytechnics have reopened

- Work is being done by the U.S Department of Health and Human Services (HHS) to design a better health care system. Grants are being provided to pay for medical attention for displaced people without health insurance. The Veterans Association is replacing the New Orleans Medical Centre at a cost of $625 million.

- The Department of Justice has assigned additional law enforcement officers to the New Orleans area to help combat crime. This includes lawyers, a Violent Crime Team and drug and forearm special agents

Eighteen Months After

Housing

- HANO is working hard to ensure that residents are aware of job opportunities and housing availability in New Orleans for when they return(Office of the Federal Coordinator for Gulf Coast Rebuilding, 2007).

- Four of the city's largest housing projects which sat under several feet of water for days have been demolished and will be rebuilt with a focus on mixed-income housing.

Economy

- American taxpayers have committed more than $110 billion to help in the rebuilding of the hurricane affected states. The National Insurance Program has paid out to policyholders $16.1 billion in claims and has now closed almost all claims (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2007).

Environment and Levees

- Louisiana has promised to use the profits from drilling along the Outer Continental shelf to restore wetlands to add additional protection from future storms (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2007).

- At this time, 82% of debris removal in the state of Louisiana is complete.

- Congress has granted the Army Corps $6 billion to rebuild the New Orleans levee systems. Reparation work on the levees continued in the months following Katrina 7 days a week, 24 hours a day. Some delays have occurred in this work through environmental and contractual problems, however, an alternative plan to provide protection to city during the levee repairs was in place.

- The Army Corps have taken responsibility for the failure of the levees during Hurricane Katrina. A report was commissioned to assess why the levees failed

pointed out that the levee system was inadequate and lacked a high degree of structural integrity. Figure 8 shows one of the breached levees being inspected by the US Army Corps.

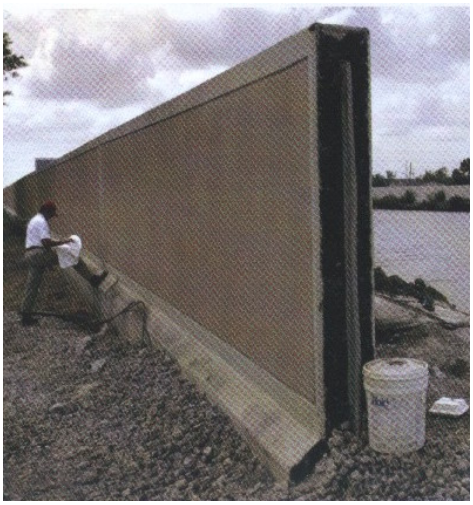

Figure 8 A member of US Army Corps inspecting 17th St Canal which was breached during Hurricane Katrina (Brinkley, 2005)

Social and Community

- FEMA's Public Assistance program, which is designed to help communities rebuild public infrastructure, has donated $6.3 million to Louisiana for reconstruction (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2007).

- The most outstanding issues to still be resolved are the additional resources needed to fight crime, improve healthcare and strengthen the levees.

Problems during Recovery

Fraud and abuse of benefits is a major problem which is inhibiting the recovery of many of the areas in the gulf coast region (Department of Homeland Security, 2006). The Department of Justice has formed the Hurricane Katrina Fraud Taskforce. The aim of this taskforce is to deter, investigate and prosecute disaster related Federal crimes. So far, 6811 complaints have been received at the Baton Rogue office. Many contractors who have won contracts to rebuild parts of New Orleans have done

substandard jobs or have fraudulently taken money. Often this has been a product of paying workers low wages skimping on materials.

One reason that people are only trickling back into New Orleans is that the health and school systems which were falling apart before the hurricane are taking a long time to recover. People who have moved may be unwilling to shift children from good schools and access to better healthcare to a substandard recovering educational and health care system (Natural Hazards Centre, 2006).

Debris has been a huge problem during the recovery, especially mould and mildew that have grown in many areas after being submerged in water for weeks. A layer of sludge that washed over flooded areas from the floor of the lake has dried covering all flooded surfaces. This has been left up to residents to clear from their properties (Allen, 2007)

Changes after Katrina

A report was commissioned by the President to review the Federal response to Hurricane Katrina. The report isolated recommendations for improving the Federal Governments response to future disaster. The Department of Homeland Security has led a series of hurricane exercises to increase official awareness and skills (Department of Homeland Security, 2006).

A negative change as a result of Katrina is the way in which vulnerable populations may now view the government and city officials. It also shows a negative side of human nature as during this event and the recovery people were murdered, robbed, aid taken fraudulently, contractors paying workers low wages and fraudulently taking money from relief donations.

Changes have been made to the National Response Plan to address inconsistencies in the plan and a quick reference guide has been developed to accompany this plan (Department of Homeland Security, 2006).

Changes to the levees and building codes particularly elevating low lying properties and the promise to increase wetlands are all good hazard mitigation strategies that have occurred as a result of the chaos of Katrina. Environmental awareness especially of the benefits of wetlands has also increased after this disaster.

Northridge Earthquake 1994

The Northridge earthquake occurred at 4:31 am on Monday the 17th of January 1994; the shaking lasted for 15 seconds (Bolin and Sanford, 1998; Chang and Nojima., 2001; Ying Wu and Lindell., 2004; Loukaitou-Sideris and Kamel, 2004; Klinger., 2006; Trifunac and Tororovska, 2004). The M 6.7 earthquake occurred on an unknown blind thrust fault under Northridge in the San Fernando Valley, 30 miles north-west of central Los Angeles. Fifty seven deaths were caused by the earthquake, nearly half of these were earthquake induced heart attacks, 5,000 people were injured and 22,000 left homeless (Klinger. 2006). The relatively low number of deaths is attributed to the time of occurrence of the earthquake. Figure 9 shows the epicentre of the earthquake.

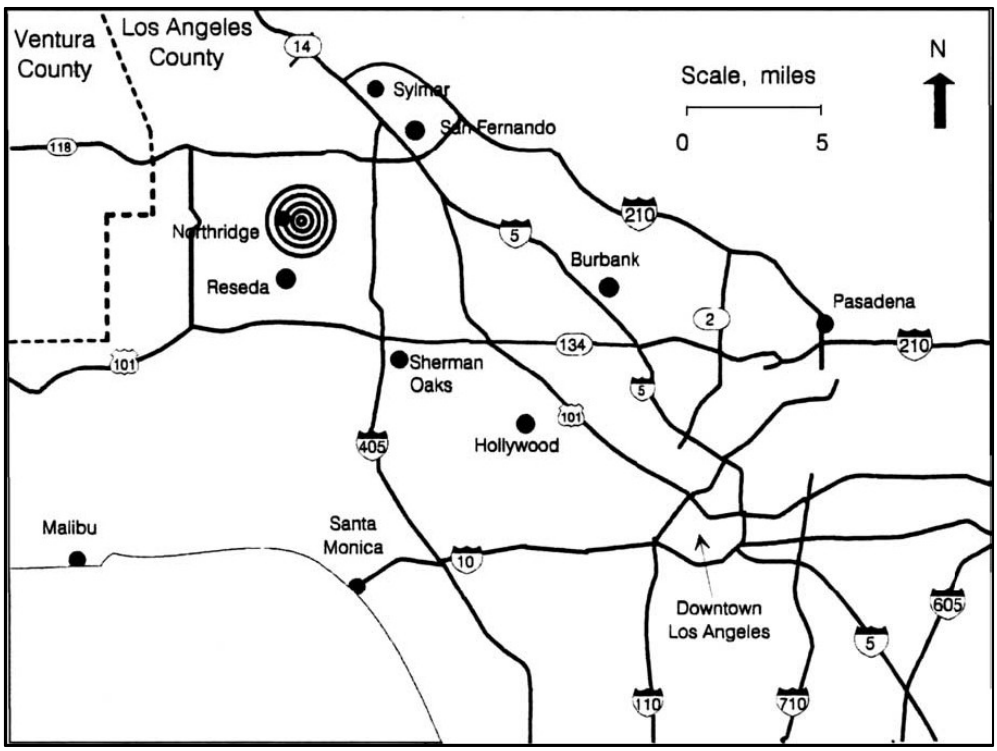

Figure 9 Epicentre of Northridge Earthquake 1994 (Klinger, 2006)

The response to the Northridge earthquake was highly successful. The U.S government had been working on a Federal Response Plan for a number of years before the earthquake. The plan was designed to coordinate the disaster response activities of 26 federal agencies and the American Red Cross. The President declared for this plan to be used for the Northridge earthquake (Bolin and Sanford, 1998; Ying Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004).

The earthquake caused landslides over a widespread area, seven major freeway sections collapsed and many houses were damaged. There was extensive damage to lifelines infrastructure. Natural gas pipelines broke, and electricity failed. In Santa Clarita and Simi Valley there was significant damage to water distribution and purification systems, as well as damage to above ground storage tanks (Bolin and Sanford, 1998; Chang and Nojima, 2001; Ying Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004; Klinger, 2006; Trifunac and Tororovska, 2004).

Many residential buildings were damaged. Apartment blocks suffered the most damage; seven times as many apartment units were damaged as individual. Many of these apartment blocks were low-income housing or were rented by young professionals (California Policy Research Centre, 2004). The Los Angles Department of Building Safety assigned red tags to destroyed buildings, yellow tags to seriously damaged buildings and green tags to undamaged or slightly damaged buildings (Bolin and Sanford, 1998; Chang and Nojima, 2001; Ying Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004; Klinger, 2006; Trifunac and Tororovska, 2004).

Other public buildings were damaged including 30 hospitals and 106 schools, large multi storey car parks built to the strictest building codes also collapsed (Klinger, 2006). This leads to the conclusion that had the earthquake occurred during the day the death toll would have been considerably higher.

Recovery

Earthquakes are not unexpected in California. The previous earthquake in California, Loma Prieta' occurred in 1989 only 5 years before Northridge. However, the Loma Prieta earthquake did not have the best recovery in terms of rebuilding affordable

housing for low-income residents. Because of the frequency of earthquakes in the region, California has some of the strictest building codes in all of the United States (Bolin and Sanford, 1998; Chang and Nojima, 2001; Ying, Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004; Klinger, 2006; Trifunac and Tororovska, 2004).

After Northridge, many of the current governmental systems used to deal with disaster recovery were inadequate. Consequently innovative social, organisational and economic programs developed. FEMA and the California Governor's Office of Emergency Services worked hard to assist ethnic minorities affected by the earthquake, something, which had not occurred during the Loma Prieta earthquake. As a result, many projects went far beyond replacing the status quo (Bolin and Sanford, 1998; Ying, Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004).

Social and Community

Recovery of lifelines infrastructure occurred rather quickly. Electricity was restored to all regions within 24 hours of the earthquake. Water services were restored after a few days; however there were disruptions to supplies for up to 2 weeks in some areas while final repairs were made. Natural gas pipelines were finally restored 12 after the earthquake (California Policy Research Centre, 2004).

Transportation was another matter altogether. Los Angles' predominant type of transportation is private automobile. The earthquake damaged 286 state highway bridges, and seven major bridges collapsed. A detour was opened on the Interstate-5 at the Gavin Canyon crossing on January 29 and the mainline road was reopened 4 months later. At the Interstate 5 and State Route 14 interchanges, detours were constructed using truck bypasses. Two of the four damaged ramps were repaired in July and the remaining two repaired in November 1994. Nine miles of the State Route-118 were damaged; detours were implemented on local streets. Partial repair opened 5 miles in mid February and the remaining 4 miles were reopened in September. The Interstate-10 had 2 bridge collapses and local streets were again used as detours. The mainline was reopened in April (Chang and Nojima, 2001). The range of detours available showed the flexibility of the transportation system and allowed people commute to work and transport of goods during the highway reconstruction

(Bolin and Sanford, 1998; Chang and Nojima, 2001; Ying, Wu and Lindel., 2004; Loukaitou-Sideris and Kamel, 2004).

Housing

The damage to houses was widespread with high levels of damage concentrated in pockets (Loukaitou-Sideris and Kamel, 2004). Over 114,000 residential and commercial structures were damaged and $25 billion was used to rebuild and repair structures (Bolin and Stanford, 1997; California Policy Research Centre, 2004) More than 48,000 apartment units needed to be rebuilt or repaired. However many owners of apartment blocks had to apply for loans as a business which had high rates of interest or did not have insurance. The City of Los Angles Housing Department (LAHD) and HUD identified areas that had high percentages of damage, especially apartment blocks that owners were considering not rebuilding. They identified these areas as ghost towns. There were 17 ghost towns acknowledged, the classification of which was 100 units vacated and more than 60% of houses red tagged. The LAHD organised loans for property owners not insured and not entitled to other government benefits through the Community Development Block Grant program. The funds were used to rebuild and ensure the latest build standards were met. Twenty percent of all rebuilt rental units had to be affordable. By January 1996, 65% of ghost town units had loans and building repairs had begun. Loan repayments were beginning and nearly all rebuilding finished by January 1999(Bolin and Sanford, 1998; Chang and Nojima, 2001; Ying, Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004; Klinger, 2006; Trifunac and Tororovska, 2004).

Economy

Under California law, local government officials can designate specific areas as redevelopment zones. Local government establishes redevelopment agencies to plan, finance and implement redevelopment strategies (Bolin and Stanford, 1998). Redevelopment agencies are eligible to receive grants from HUD to promote affordable housing. Before the Northridge earthquake Santa Clarita and Fillmore has redevelopment agencies in place. The towns of Fillmore and Piru were concerned with historic preservation after the earthquake as there tons are used as early 20th century town movie sets which generates income for the towns. As this was important

for these towns the asked members of the movie industry to help in redesigning the town to make it even more appealing as a film set. While redevelopment agencies are not designed to specifically meet the needs of earthquake recovery they are often used by city officials to promote recovery while also promoting ongoing development both economically and socially (Bolin and Stanford, 1998).

Planning and Policy

In 1987, the City of Los Angles began to create a post- earthquake recovery and reconstruction plan for the city. The recovery and reconstruction plan has four key themes: planning, hazard mitigation, short term and long-term recovery. It assigns responsibility for 300 actions to departments or agencies within city government (Loukaitou-Sideris and Kamel, 2004).

At the time of the Northridge earthquake, the plan was on the agenda of the Emergency Operations Board awaiting approval. The plan was approved for use 5 days after the earthquake. Officials interviewed about using the recovery and reconstruction plan commented that they did not necessarily refer directly to the plan but that they knew what their responsibilities were and what needed to be done because of the planning process. They also found that many of the issues they may have encountered had been resolved during the planning stage also (Ying, Wu and Lindell, 2004).

Overall, the recovery of the Northridge earthquake was successful. This is due to a combination of factors. Firstly, the earthquake occurred in a congressional election year; therefore, the situation received immediate political attention. This may partially explain the speed and large amounts of federal funding giving to victims of the quake. Secondly, the Loma Prieta earthquake of 1989 did not have an adequate recovery of housing units, especially for low-income earners. This problem was addressed during the Northridge earthquake by targeting ghost towns and encouraging them to be rebuilt (Bolin and Sanford, 1998; Ying Wu and Lindell, 2004; Loukaitou-Sideris and Kamel, 2004).

Another factor that contributed to the recovery was the redevelopment agencies that were present in many of the neighbourhoods before the earthquake and then incorporated recovery into their redevelopment plans. This ensured that recovery and development were occurring simultaneously, instead of development coming to a standstill during recovery. Recovery of housing after the earthquake was a complex programme. However, the recovery was made easier by using new and innovative funding schemes it help those who would have otherwise not received any.

Discussion

What is clear from studying these cases is that all aspects of disaster management are crucial to recovery. This is particularly evident in the recovery of New Orleans. The response to the hurricane was so appalling that it seems many have lost all trust in City Officials and are not prepared to move back to the city. This also means that people who do move back into the city may be there simply because they have no other choice. This may lead to frustrations and conflicts between these people and authorities during and after the recovery period.

It is also interesting to compare Katrina and the Northridge earthquake. Earthquakes are a frequent event in California, as hurricanes are frequent on the gulf coast. What is strikingly obvious is the difference in readiness and disaster mitigation that has gone on between the two regions. California in the 1990's was miles ahead of New Orleans in 2005 in terms of planning and risk reduction.

Comparing Northridge and Katrina to the Boxing Day Tsunami is somewhat less obvious. However, the most noticeable difference is the way vulnerable populations have been treated between one of the richest countries and some of the poorest countries. In Sri Lanka and Indonesia, the tsunami recovery has brought peace to some areas but renewed war to others, vulnerable populations are being considered in rebuilding and receiving benefits. In New Orleans, there are still vulnerable groups who are not entitled to benefits, and 18 months after the disaster some poor areas are still without power. In Northridge, vulnerable populations were taken care of, ensuring they received benefits to allow them to rebuild.

In both Katrina and the Boxing Day Tsunami, it is clear that environmental recovery especially coastal rehabilitation is an important part of the reconstruction phase. It seems evident that this kind of environmental attention would not have occurred if it were not for a disaster of this scale.

Sri Lanka's and Indonesia's property issues suggest that this could have been something that could have been avoided with prior planning. Sri Lanka would not have made a hasty decision to stop development close to the ocean only to revoke this after a few months, which delayed reconstruction. Surveying and official land ownership could have been an ongoing project in Indonesia, which would have speed up some rebuilding.

These disasters parallel with Napier 1931 even though they occurred at different times and in different cultures. Clearing debris was a major problem in Napier just as it has been in Sri Lanka, Indonesia and New Orleans. Perhaps the most obvious similarity is the lack of housing especially for low income groups and the associated cost of rebuilding. Encouraging people back to Napier was not as much of a problem as it has been for New Orleans however this is perhaps more to do with the response to the disaster than just the recovery alone. The other major similarity is restarting the economy Napier has similarities to both the recovery of the tsunami and Katrina in this respect as the 1931 earthquake occurred in the depression. Although not commodity based New Zealand economy is agricultural based, with falling export prices during the depression this put a strain on the local economy where damage occurred to industry and farms. Diversifying income as has occurred in tsunami affected countries would increase the resilience of income for farming based families.

Conclusions

* Effective recovery is reliant on effective preparation, risk reduction and response.
* Northridge recovery was the most successful of the three examples followed by Boxing Day Tsunami. In these examples, there was a combination of prior planning, effective response and attention to vulnerable populations.

* Where industry and development are of major concern it may take a disaster to realise that natural barriers are probably the most effective in terms of reducing disaster risk.
* Prior planning may help to solve issues that would otherwise draw out the recovery process e.g property rights
* Groups who should take responsibility for and plan for disaster may not do so effectively.

Chapter 3 - Case Study: Napier 1931 Earthquake

Introduction

The city of Napier is situated in the Hawke's Bay region on the east coast of the North Island, New Zealand. The Crown purchased the block of land which Napier occupies in 1851 (Conly, 1981). By 1854, the town had been planned and named Napier, after Sir Charles Napier a soldier who had fought in India. The streets were named after famous artists and literary figures. The development of Napier was confined to the hill known as Scinde Island and the port at Ahuriri. At this time, Napier consisted of hills surrounded almost entirely by water. Two single spits ran to the north and south of Scinde Island. As the town developed, a hill was levelled to create Clive and Memorial Squares. A severe earthquake hit the town in 1863, however damage was minimal as the town was still in the early stages of settlement. Another earthquake struck the town in 1931 and changed the topography and the development potential of the town dramatically (McGregor, 1989).

Geological Setting

The Hikurangi Subduction Zone is located along the east coast of New Zealand as part of the Tonga- Kermadac Trench, where the Pacific plate subducts under the Australian plate (see

Figure 10A). It is along this margin that the ocean-to-ocean subduction of the Kermadac trench makes the transition to strike slip and continental-continental crust collision in the South Island. The margin is approximately 500 km long, 480 km wide and accommodates the oblique motion between the Pacific and Australian plates. The convergence rate of the plates is about 50 mm per year (Hayward et al 2006).

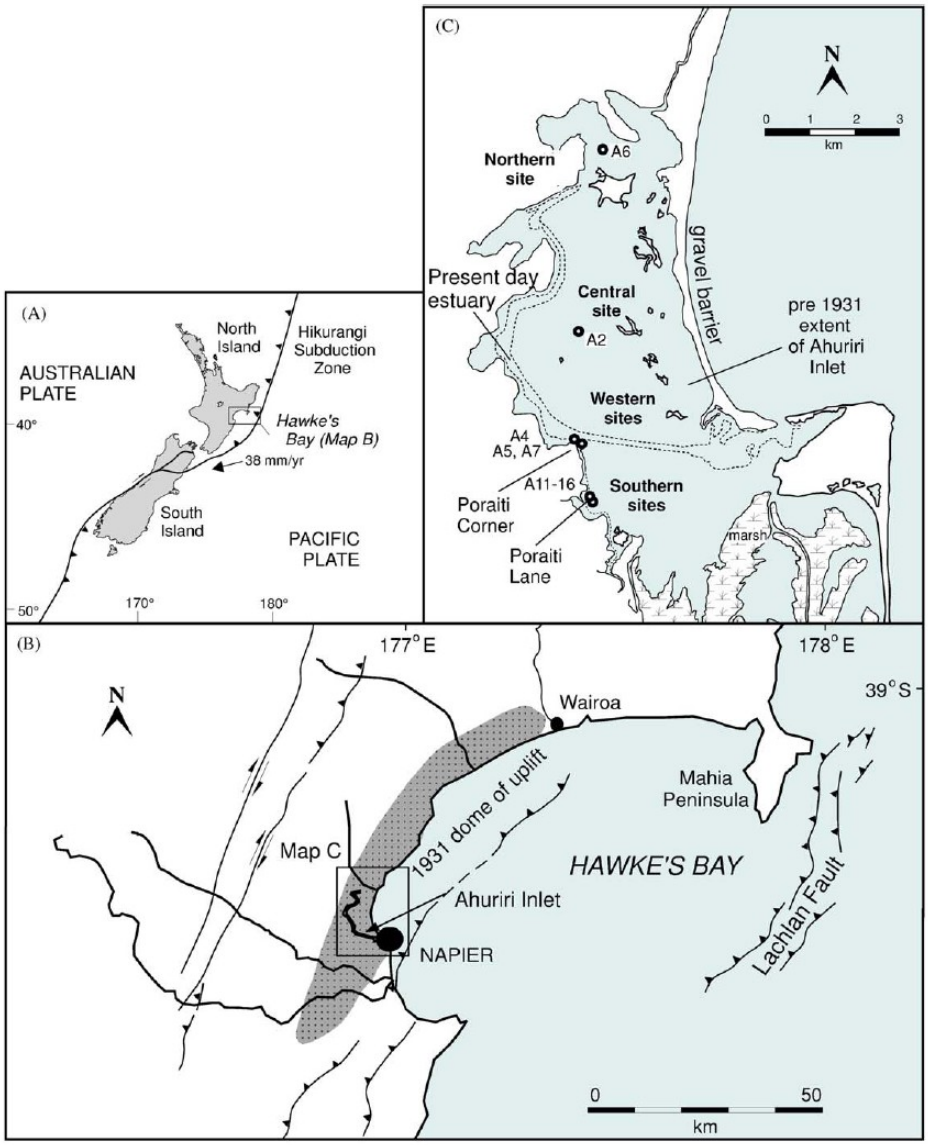

Figure 10 (A) Map of Hawke's Bay Map of New Zealand showing location of Hawke's Bay in relation to the Hikurangi Subduction Zone on the Plate Boundary. (B) Map of Hawke's Bay region showing location of major active faults (Barnes et al, 2002) and dome of land uplifted during the 1931 earthquake (Hull, 1990a). (C) Pre-1931 Ahuriri Inlet and Post 1931 estuary shown by dashed line (in Hayward et al, 2006)

Napier is situated in the forearc basin and prone to earthquakes and tsunami from the close proximity of the subduction zone. Volcanic ash is also a problem for the town as the associated subduction volcanism, the Taupo Volcanic Zone, lies west of Napier.

Hazards likely to affect Napier

Earthquake

The Hawke's Bay region is one of New Zealand's most seismically active areas. This is due to the proximity of the Hikurangi Subduction Zone. About 160 km east of Napier the Pacific Plate begins to subduct obliquely under the Australian Plate. The Pacific Plate dips at an angle of 4-6° but steepens beneath Hawke's Bay to around 25° (Hawke's Bay Engineering Lifelines, 2001; Hayward et al, 2006).

This subduction zone is unusual in two ways. Firstly, a larger proportion of the convergent margin is above sea level than in most subduction zones (Hawke's Bay Engineering Lifelines, 2001). This could result in the effects of large earthquakes occurring closer to land than they usually would. Secondly, the oblique convergence of the two plates results in strike-slip faulting parallel to the coast. However, the motion perpendicular to the coast is largely unaccounted for. It is assumed that this motion is taken up by slip on the subduction interface and slip during thrust earthquakes on shallow faults between the Hikurangi trough and the axial mountain belt.

Three types of earthquakes occur in the Hawke's Bay region due to the stresses in each plate and at the interface of the plates (Hawke's Bay Engineering Lifelines, 2001).

Type A earthquakes: These earthquakes occur in the over-riding Australian Plate caused by the transfer of stress from the coupling of the two plates at the subduction interface.

Type B earthquakes: This kind of earthquake occurs at the interface between the subducting Pacific plate and the over-riding plate.

Type C earthquakes: These earthquakes occur in the top part of the subducting Pacific Plate as it bends under the Australian Plate.

Of these three types of earthquake, type A and B are thought to cause the most damage. Type A may not be as large as Type B but Type A earthquakes may often be closer to the surface and population centres. Type B earthquake that occur on the subduction interface are generally larger as shown in (Hawke's Bay Engineering Lifelines, 2001).

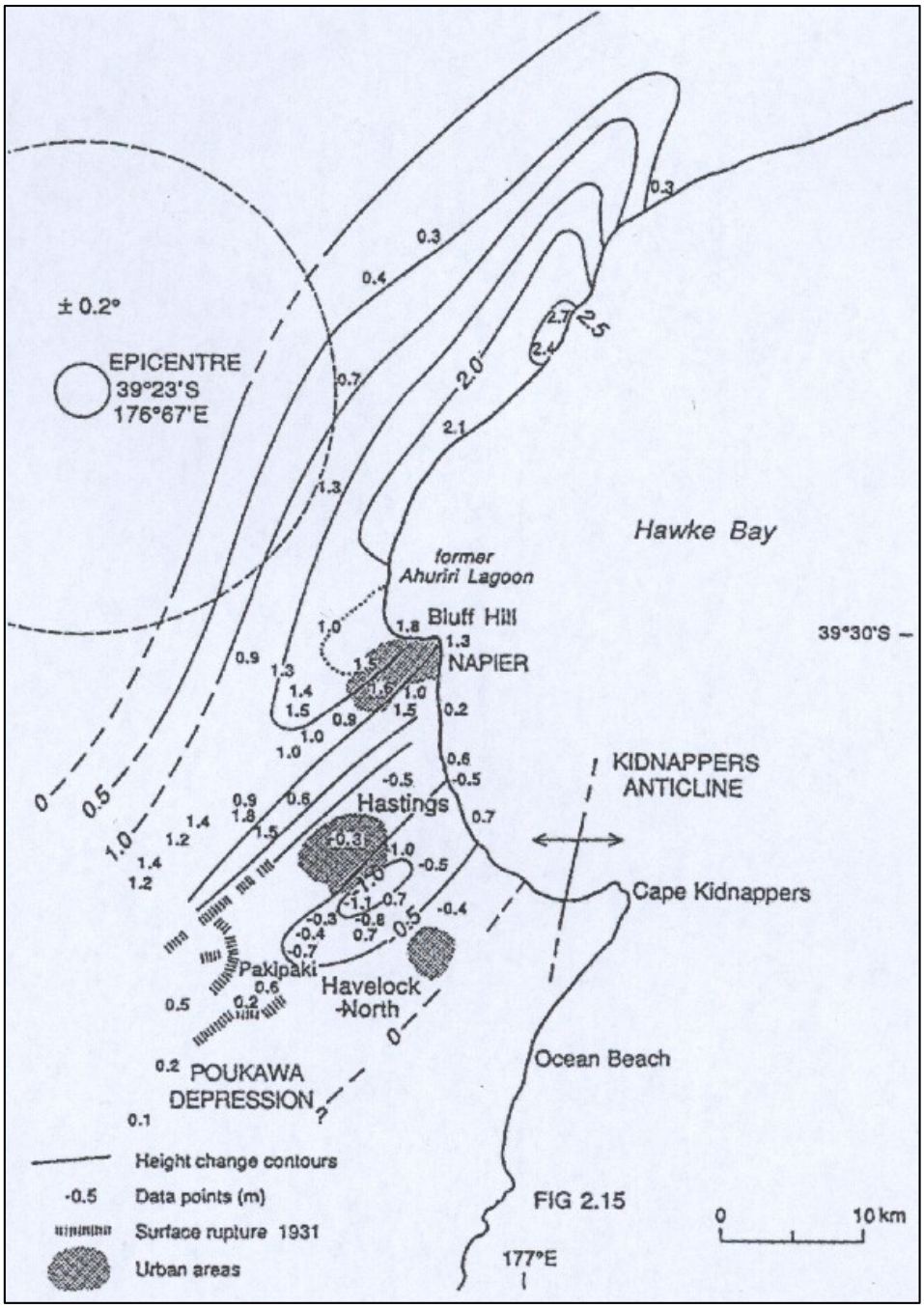

Figure 11 Subsidence and uplift associated with Napier 1931 earthquake. Elevation change in metres (Hawke's Bay Engineering Lifelines, 2001)

There are at least 22 known active faults in Hawke's Bay. Two of these faults, the Ruahine and Mohaka faults, are northeast- trending strike-slip faults, and are segments of the Wellington Fault. The Napier- Hawke's Bay Fault trends north-west and is thought to be the fault which ruptured in the 1931 earthquake, as the line of zero deformation traces the outline of this fault as shown in
Figure 11 and

Figure 10C. The 1931 earthquake was the first rupture on this fault for 1800 years (Hawke's Bay Engineering Lifelines, 2001).

The earthquake that is possibly of greatest risk to Hawke's Bay is a large subduction earthquake (Type B earthquake). An M 7.7 earthquake with an average slip of 3m on the plate interface has been predicted for this region. This event has a recurrence interval of 550 years. Hayward et al (2006) show that subsidence is the overall trend in Hawke's Bay; there have been at least 6 subsidence events in the last 7000 years, with a return period of 1000-1400 years in southern Hawke's Bay. It is believed that these subsidence events (8.5 m total subsidence) are the result of subduction earthquakes while the 1931 earthquake which caused uplift (1-2m), is the result of a local fault in the crust of the over riding plate.

Aside from damage caused by shaking, three other major effects could occur as the result of a large earthquake: liquefaction, tsunami and either a landslide or a submarine landslide. Tsunami and landslides are discussed later in this chapter; liquefaction will be discussed here as it is solely related to earthquakes.

Liquefaction occurs where sediments lose their ability to bear strength to due shaking. This is of particular concern when development occurs on unconsolidated or partially consolidated material. An earthquake needs to have shaking intensity of around MM 7 for liquefaction to occur. Liquefaction can occur in two ways. Firstly, settlement may occur, where due to shaking, sediment compacts. This may cause a change in elevations, which has been estimated to be about 1m in Napier. Secondly, lateral spreading can occur and 15m of lateral spread has been estimated to occur during a large earthquake in Napier (Hawke's Bay Engineering Lifelines, 2001).

Volcanic Ash

The volcanoes of the central North Island are associated with the Hikurangi Subduction Zone. The Taupo Volcanic Zone (TVZ), one of the most active ryholite areas on earth, is the result of the melting of the down-going Pacific plate (Kissling and Weir, 2005; Smith et al, 2005). As the plate melts, magma is produced and the buoyancy of the magma compared to the surrounding rock causes it to rise to the surface creating a volcano.

Because of the distance of the volcanoes from Napier, the city is not at risk from lava, pyroclastic flows or lahars. However the town of Napier is downwind of the volcanoes which means that it is prone to volcanic ash deposits which are carried by the prevailing winds south-east towards the city. This has occurred in the past, with at least three layers of rhyolitic tephra found in deposits around the area (Hayward, et al, 2006). The last time ash affected Napier was the 1995-6 eruption of Mt Ruapehu in the TVZ (Hawke's Bay Engineering Lifelines, 2001).

The very fine nature of volcanic ash can cause major problems, by blocking filtration equipment, contaminating water supplies, causing respiratory problems, short circuiting electrical systems, causing damage by weighing structures down (especially if wet) and disrupting transport and communication systems, especially air transport (Hawke's Bay Engineering Lifelines, 2001) . Another problem with ash is the requirement to clean up and dispose of it in a safe, environmentally responsible way. The expected ash falls for Napier are shown in Table 2.

Table 2 Expected Ash Thicknesses for Napier (Hawke's Bay Engineering Lifelines, 2001)

Expected Ash Thickness (mm)	Frequency of Occurrence (Years)
0-1	10-20
1-5	100
5-50	2200
50-100	3000
Over 100	5000

Tsunami

Tsunami are ocean or lake waves caused by displacement of water by seismic or mass movements. They are characterised by fast travel speeds of around 950 km/hour, long wavelengths of about 200 km and long periods of approximately 10-60 minutes (Hawke's Bay Engineering Lifelines, 2001). Napier is at risk from tsunami, which may be caused by a number of mechanisms.

Submarine subduction earthquakes are more likely to cause tsunami than any other kind of earthquake as they tend to have long rupture duration, and may have large amounts of displacement along the plate interface, which in turn displaces the water above (Hawke's Bay Engineering Lifelines, 2001). Tsunami may be caused by other types of offshore earthquake, however tsunami from this kind of earthquake are generally not as large. Terrestrial earthquakes can cause tsunami by generating either a coastal landslide, which will displace water as it falls into the sea or by creating a submarine landslide displacing water in the same way as a landslide. Evidence shows that a large submarine landslide about 3,600 km^3 in size may occur every 100,000 years occurred off the coast of Napier (Hawke's Bay Engineering Lifelines, 2001). It is almost certain that a submarine landslide this large would generate a major tsunami.

Napier's close proximity to a subduction zone and other associated submarine faults means it is at real risk from a tsunami. There is evidence to suggest that there have been tsunami caused by earthquakes in the past (Hayward et al, 2006). Estimated tsunami events for Napier are shown in Table 3.

Table 3 Maximum Tsunami Heights for Napier (Hawke's Bay Engineering Lifelines, 2001)

Maximum Tsunami Height (m)	Probability of Exceedance (years)
8m	10% in 15 years
11m	10 % in 50 years
20m	1% in 50 years

Tsunami cause enormous amounts of damage as the wave flows into an area, however damage is also caused by the back flow as the water has often picked up large amounts of debris by this time. The force of the water and flooding damages

structures, roads and rail are lifted by the water and back scour, sanitation and filtration plants are often damaged by flooding also.

Landslide

As previously discussed, earthquakes often cause landslides. The 1931 Napier and 1932 Wairoa earthquakes both caused large landslides including one on Bluff Hill Napier, and one that blocked the Te Hoe River at its confluence with the Mohaka River. A 30m high debris dam was formed, which formed a lake 5 km long.

The other common cause of landslides in Hawke's Bay is extreme weather events. High rainfall from events such as Cyclone Bola can cause landslides. Rainfall of more than 200 mm a day may cause landslides in some areas while rainfall of more than 250 mm per day is likely to cause widespread landslide damage (Hawke's Bay Engineering Lifelines, 2001).

Other Hazards

Napier and the Hawke's Bay region are affected by other more frequent events, such as flooding, drought and snow. The other most likely event is uncontrolled fires. It is unlikely that these events would cause damage on the same scale as earthquakes, volcanic ash, tsunami or landslides as there is generally more warning time available for meteorological events and the effects are more widely understood from experience.

1931 Napier Earthquake

Event

The Napier earthquake occurred at 10:47 am on the 3rd of February 1931. The M 7.8 earthquake lasted for two and a half minutes (McGregor, 1989; Hawke's Bay Engineering Lifelines, 2001; Hayward et al, 2006; Wright, 2006). During this time chimneys, buildings and masonry collapsed and a area of land 90 km x 17 km was uplifted a maximum height of 2.7 m as shown in Figure 10. This uplift is attributed to the folding of young elastic rocks above a buried fault (Hayward et al, 2006).

Within minutes of the earthquake, fires broke out when a naked flame knocked over in a pharmacy came into contact with flammable materials (Wright, 2006). The flames spread rapidly through the town while the Fire Brigade could do little as the earthquake had severed the water supply system. The Fire Brigade attempted to back fire engines down to the beach however shingle blocked the hoses. As the fires raged on, rescuers tried to save as many people as they could, however some were stuck under heavy beams and could not be rescued. Some were given morphine and left to await the fires as nothing more could be done for them.

The business area of Napier was hardest hit and this is where the majority of deaths occurred as most masonry buildings were destroyed (see Figure 12) (Wright, 2006). Heavy parapets, gable ends or ornamental features falling on people caused many deaths. Steel beams not attached to walls trapped many people in damaged buildings; others were buried with bricks as they tumbled across the street. The uninjured rescued injured often pulling bricks and masonry off them with bare hands.

The hospital was badly damaged and people were evacuated to the botanical gardens. An emergency plan had been prepared six years earlier for this kind of situation. Following the plan, an alternative hospital was set up at the Racecourse, with an operating theatre and tents to provide accommodation. In addition, the nurse's home was destroyed killing several nurses who were sleeping in the building.

Figure 12 Earthquake and fore damaged CBD, Napier 1931 (www.napier.govt.co.nz)

The Navy were particularly helpful during the response from the earthquake. The HMS *Veronica* was already stationed in the harbour after arriving in Napier a day earlier, as was the freighter the *Northumberland* which was being loaded with frozen meat (Wright, 2006, McGregor, 1989). The *Northumberland* raised the alarm first at 11:20 am to 'all stations' followed by an alarm from the motor vessel *Taranaki* a few minutes later to Wellington. HMS *Veronica* radioed naval bases which then passed the information on. The HMS *Dunedin* and HMS *Diomede* arrived in Napier at 8:30 am on the 4 of February bringing tents, blankets, beds and shovels.

Aftershocks left people too scared to stay in their houses and many camped out on the beach along Marine Parade, at Nelson Park and other open areas. A large aftershock at 9:00 pm caused further damage (Wright, 2006). Another large aftershock on the 13 of February caused a landslide that blocked a river near Willow Flat. Altogether 525 aftershocks took place in the two weeks after the main earthquake.

Nelson Park was organised by the army as a temporary shelter and evacuation centre. Latrines were dug, water pipes laid and kitchens set up in the pavilion. Around 2000 people sent the night of February 4 in tents at Nelson Park. The Napier Earthquake Executive Committee decided that for health reasons women and children should be evacuated, but able-bodied men were required to stay behind. The Mayor of Palmerston North offered to take 5000 refugees. By the end of the first day 1000

women and children had been evacuated. Evacuation stopped on the 16th of February, by which time 6,700 people had been evacuated through Nelson Park and another 2,000 had independently evacuated (Wright, 2006; McGregor, 1989).

Shortly after the earthquake the Napier Citizens Control Committee was formed to take care of safety, public health and administration of the town. As people began to move back into their houses the committee circulated pamphlets on sanitation and health care precautions as well as other safety information.

Dynamite was required to dig the communal grave. The dead were buried on the 5th with an interdomininational service held.

HMS Veronica left on the 10 of February. Over the next few days Acetone and Illuminating and Wielding Company LTD, Humphries Cash Groceries opened in their undamaged premises and on the 16th the banks opened in an undamaged building

The earthquake damaged flood protection works. The Prime Minister allocated a grant of £10,000 to repair the stop banks before the autumn rains. The work on the stop banks was finished within a month (Wright, 2006).

Recovery

The morning after the earthquake the Napier Citizens Control Committee was formed, and for the following 5 weeks it was the entity primarily responsible for rescue and rehabilitation of Napier (Annabel, 2006). On the 11 March retired magistrate J.S Barton and retired engineer L.B Campbell were appointed Commissioners of Napier, temporarily replacing the city council (Wright, 2006; McGregor, 1989; Annabel, 2006). The Commissioners along with the Napier Reconstruction Committee headed the reconstruction of Napier.

In the aftermath of the earthquake there was discussion about rebuilding the central business district (CBD) of Napier on the other side of the hill near the newly uplifted land. However this never eventuated and the CBD was kept in its original location with the original colonial street pattern. Rebuilding in the CBD was suspended

directly after the earthquake so debris removal could occur and planning matters could be resolved (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004).

The Daily Telegraph ran an editorial in April of 1931 commenting on how Santa Barbara had been rebuilt after an earthquake in 1925 in the Spanish architectural style (Figure 13). This view was supported by Napier's architects and under the guidance of the Napier Reconstruction Committee plans were developed accordingly.

Figure 13 Typical Spanish Mission Style architecture (www.napier.govt.nz)

As a result of the earthquake there were new building regulations. The Building Construction Act passed at the beginning of 1932 in response to the earthquake imposed uniform codes on new construction nationally. The Act provided standards and laid the foundation for additional improvement. However a special fee attached to new building permits to fund research into earthquake resistance was not well received (Wright, 2006).

Napier's recovery followed the phases of recovery outlined by Haas et al (1977):

1. *Emergency Period*- Lasted for about 3-5 days after the earthquake during which time the dead were recovered and buried, the injured received medical attention, temporary accommodation and evacuations organised

2. *Restoration Period*- During this period all services were restored and fully repaired. The buildings were demolished, and debris cleared, evacuees returned and people moved back into undamaged housing.

3. *Replacement Reconstruction Period* -The Market Reserve Building was the first building to start construction in August 1931 and finished in June the following year. During this time other businesses and homes were rebuilt, the economy was kept going with the opening of Tin Town The end of this period would have occurred about January of 1933 with the carnival and celebration of the 'new Napier.

4. *Commemorative, Betterment or Developmental Reconstruction Period*- This occurred after the new Napier carnival and includes the development of Marine Parade- the sound shell, colonnade and commemorative arches. The Veronica Sun Bay in commemoration to the sailor of HMS *Veronica* for the help they provided after the earthquake. Also the development of the uplifted land into the airport and new suburb of Marewa.

Tin Town

As the disaster took place during the great depression, shopkeepers could not afford to stay closed for long. A government grant of £20,000 allowed a temporary shopping centre to be built. Construction started on February 17. Shops were located on Clive Square while professional offices were set up on Memorial Square. The shopping centre was named 'Tin Town' as it was built out of corrugated iron shown Figure 14 (Wright, 2006; McGregor, 1989).

The Central Business District

The legislative background for Napier's reconstruction was provided by the Hawke's Bay Earthquake Act 1931 and the Town Planning Act 1926(Annabel, 2006; McDonald, 2004). Under the Town Planning Act every borough council with a population over 1000 was required to prepare a town planning scheme and summit this to Town Planning Board to be approved. The town commissioners decided not to

Figure 14 Tin Town, Clive Square Napier (www.artdecotrust.co.nz)

plan a scheme that covered the whole of Napier as it would take too long before rebuilding could commence. Regulations were changed so that a plan for only the CBD could be developed and the usual period of public notification was short cut.

The plan contained clauses for betterment, street widening and related matters. Street widening had been planned before the earthquake as the colonial streets were now too narrow for cars. Negotiations occurred with land owners, many did not take compensation for street widening as it was for the greater good; for example, shop owners on Tennyson St sacrificed 3m from the front of their properties without compensation (McDonald, 2004). However £30,000 was paid in compensation to property owners at the direction of the Commissioners. Corners were splayed to improve sight lines at intersections for motorists, and service lanes were added (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004).

All power and telephone lines were placed in trenches beneath footpaths that were formed in concrete slabs so repairs could be easily made (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004). Verandah poles were prohibited; all verandahs were suspended with standardised widths and fascia heights. By December of 1931 the scheme was ready for inspection and objections. The scheme gained final approval by March 1932. The first building to be reconstructed was the Market

Reserve building which was planned prior to the earthquake and was used as a symbol of recovery from the earthquake.

Marine Parade

In addition to the reconstruction of the CBD, Marine Parade the boundary between the CBD and the ocean was in need of reconstruction too. The Thirty Thousand Club formed in 1913 with the goal of increasing Napier's population to 30,000 was responsible for development of Marine Parade (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004).

The Napier Reconstruction Committee, the Commissioners and the borough council worked with the Thirty Thousand Club on the redevelopment of the parade (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004). Parts of Marine Parade rose along with the rest of the land during the earthquake. Rubble from the town was dumped along the foreshore and levelled. This was concreted and an open air auditorium and gardens were built, along with the Veronica Sun Bay in commemoration of the naval vessel that helped during the earthquake, the sound shell, colonnade and arches.

Harbour

The land uplifted by the earthquake was leased by the council for development. In 1934 a drainage scheme began to prepare the land for development, this included diverting the Tutaekuri River and constructing drainage channels for rainwater to dilute the salt from the soil (Wright, 2006; McGregor, 1989; Annabel, 2006; McDonald, 2004). Development of the suburb of Marewa began in 1935. The road layout differed from the rest of Napier at the time with angular and circular streets instead of the traditional grid style. The area was promoted as a model garden suburb and was used as the model for other Napier suburbs. However it was changed considerably by the Labour government's state housing program. Some of the state houses were begun in the late thirties however construction stopped during the Second World War and began again in the fifties (Annabel , 2006).

The uplifted lands also settled a long running Napier argument over where the harbour should be. As the harbour could no longer be in the former lagoon it was located at the base of Bluff Hill.

Housing

About 90% of wooden framed houses suffered no damage except for a falling chimney (Chapple, 1997). There was some structural damage to two storey houses and houses made of wood, including fractures of timber, window panes and roofs in some part of Napier. The Hawke's Bay Earthquake Act granted £1,500,000 to Hawke's Bay, of the grant £1,250,000 was for private relief and the remaining £250,000 for local bodies.

The Earthquake Relief Committee allocated £100 per house for housing repairs. A reputable builder needed to estimate the costs and then the grant was approved. The population of Hawke's Bay rose by about 6,000 people overnight as people came for building jobs. This put pressure on existing accommodation and forced rents up. Rent prices did not return to normal until 1936. The increase in population was probably in response to people looking for work. The building sector in Napier increased between 1932 and 1934 when most of the rebuilding occurred. However this caused conflict in the community as out of town people were often given work over locals. Most places began to employ a certain amount of local people (Wright, 2006).

Economy

Napier was an agricultural service town for the Heretaunga Plains (Chapple, 1997). In 1931 the basis of the economy was agriculture, primarily meat, wool and dairy products. Meat and diary products were processed in the area and then exported either by rail or from the Port of Napier. Frozen meat that had been awaiting export before the earthquake was examined then cleared for export.

Implications of 1931 earthquake for New Zealand

The 1931 Napier Earthquake had a profound effect on New Zealand. Formal earthquake planning, building regulations and the mechanisms required to fund recovery after a natural disaster can be traced back to the 1931 earthquake (Wright, 2006).

While the central government provided various forms of assistance, coping with the disaster was seen as largely the responsibility of local agencies, which were completely unprepared for this task (MCDEM, 1990). Citizens' committees were formed to co-ordinate rescue and relief operations, but their lack of authority and support led to difficulties. The Public Safety Conservation Act in 1932 was passed in response to such problems. However the Act made no provision for either central or local organisations to plan for disasters. The few local authorities that did take note of Hawke's Bay's experience and prepared to meet similar crises did so, on their own initiative; by this action they provided the basis for wartime civil defence. Civil Defence was more formally organised during the Second World War but its beginnings were as a result of the destruction of the Napier earthquake.

The loss of life and devastation to the buildings in the CBD of Napier were the catalyst for the beginnings of a building code in New Zealand (Wright, 2006). By 1931 technology had advanced to make buildings designed to withstand earthquakes. Building codes were drawn up in 1931 specifically from the Napier quake and in 1932 Standards New Zealand was established. They produced model building bylaws to be adapted by local authorities. Earthquake insurance was available in 1931 but the majority of people did not consider it necessary. However, as technology increased and more was known about engineering buildings to withstand earthquakes, compulsory earthquake insurance began in 1944 (Wright, 2006).

The pre planning that occurred before the 1931 earthquake did help significantly in the post event situation. The hospitals pre planning of an emergency site helped to ensure that patients received adequate care after the hospital was damaged, and existing patients did not suffer additional stress or injury. Pre planning of street

widening and service lanes which was incorporated into the rebuilding has meant that the traditional colonial street pattern is still functional today. This shows that pre planning for recovery is a valuable asset.

Differences between 1931 and Today

Perhaps one of the most striking differences between today and 1931 is the change in the social structures of society. Communities now have more high density housing and greater ethnic mixing than in 1931. This results in many changes.

As a consequence of high density living there is a possibility of more racial mixing which means that there are different languages and cultures mixing together. In a time of disaster this can leave one ethnic group more vulnerable than another as they may have less access to resources and have language and cultural barriers. They may also be less likely to have family in other locations that they may stay with immediately after the disaster.

Many people who lived through the 1931 earthquake had lived through or served in the First World War. Many of the earthquake survivors that had served in the war compared the scenes after the earthquake to what they had seen on the battlefield (Wright, 2006). It may also be argued that there was more of a sense of community between people in 1931, because neighbours were known compared to now where they often remain strangers.

High density living puts more pressure on infrastructure as there is a concentrated use in a small area. This may cause more bottle-necks in traffic when trying to evacuate people. In 1931 not every household owned a car. These days most households own at least one car which increases the number of cars on the road and consequent congestion during evacuation. Evacuations for Hurricane Katrina began 2 days before the hurricane made landfall. It took 2 days for New Orleans to be evacuated essentially of all car owners. The were so many cars that even with all lanes open for outgoing traffic many evacuees were stranded in their cars on the highways when the hurricane hit (Department of Homeland Security, 2006).

This also shows another change in communities now. People have more invested in their homes and contents than in 1931. As well as the earthquake occurring in the depression it occurring in a time of less technology and therefore less 'home comforts' which greatly reduced the economic effect of the disaster compared to a similar event today. However by having more invested in homes and contents people may be encouraged to have insurance. Disaster insurance is available for anyone who has home and contents insurance through the Earthquake Commission (EQC). If a person has house insurance they automatically received disaster insurance, however only land is covered during a flood or storm. This is often because people live in flood prone areas and may not be covered for flooding through their insurance company. Therefore they are not covered by EQC.

Another major difference between today and 1931 is differences in legislation and understanding in environmental processes. In 1931 it was not understood how earthquakes occurred. Today much more is known about what causes natural disasters. There are Building Codes to ensure buildings are constructed to resist the forces of earthquakes. The environment has become much more important now and there is legislation in place (RMA 1991) to ensure it is protected; for example, debris from an earthquake could no longer be dumped on the oceans foreshore.

Our dependence on lifelines is more pronounced than in 1931. We rely more on appliances and power supplies for everyday life than communities in 1931 did. We rely on unseasonable food that needs to be transported and stored. People are less likely to be self reliant now than they were in the thirties. The form of money used has changed to the extent where most people do not carry cash. If a disaster causes loss of power then these people are left without the means to withdraw money as no eftpos and ATM systems would function.

Changes in ownership of infrastructure would also change the way in which lifelines where restored. In 1931 most lifelines were government owned, which meant that their first responsibility lay with the public (Wright, 2006); whereas today not all lifelines are government owned and the owners' first responsibility may often be to

shareholders to ensure profits are not lost, than restoring services as quickly as possible.

Conclusions

- Napier is at risk from numerous hazards as a result of its close proximity the Hikurangi Subduction Zone.
- The 1931 earthquake and associated fires caused the worst natural disaster in New Zealand's history.
- As the earthquake occurred during the depression the main focus was on reopening shops as soon as possible
- To prevent shoddy construction and to allow debris removal building was prohibited until the rebuilding was planned and a temporary shopping centre was built.
- The recovery of Napier included mitigation measures such as street widening, services laid under pavements, and new building codes.
- Pre planning which gave to reconstruction a focal point to centre recovery around. The pre planning played a significant part in the recovery of Napier.
- The rebuilding took inspiration from America, in the Spanish Mission and Art Deco styles instead of traditional colonial architecture
- The Napier earthquake changed how disasters were managed in New Zealand by leading to compulsory earthquake insurance, building codes and foundation of Civil Defence.
- Recovery today would be different from recovery in 1931 as communities, vulnerability and legislation have changed, as well as the ownership of lifelines services.

Chapter 4-Relevant Legislation

Introduction

The legislation relating to natural disaster and hazards in New Zealand is broad and complex. The three Acts that underpin natural hazard and disaster management are the Resource Management Act 1991, the Civil Defence Emergency Management Act 2002 and the Building Act 2004. All of these acts are focused towards sustainable management and development, which is a holistic approach and integrates many different environments and groups. Disaster recovery needs to integrate many different environmental systems and the laws which govern them. These laws are focussed on reduction and preparedness, two important aspects of hazards management; however, they are not focused towards being functional for use during recovery after a disaster.

Resource Management Act 1991

Background

Resulting from environmental problems in the 1970s the first United Nations Earth Summit was held in Stockholm, Sweden in 1972. This was the first time that sustainable development was discussed by world leaders as a means of resource and environmental management. It was not until the 1980s in New Zealand when two major Acts (Water and Soil Conservation Act 1967 and the Town and Country Planning Act 1977) needed to be reviewed, that the idea of sustainable development became the underpinning principle of legislation.

The Resource Management Bill was prepared under a Labour government and put to Parliament in 1989; however, Labour then lost the 1990 election. The Resource Management Bill was revised by the National government and passed in 1991 as the Resource Management Act. This new Resource Management Act repealed 78 other acts and statues. The Resource Management Act 1991 ("RMA") was groundbreaking, being the only piece of legislation that managed water, land and air under one law.

Putting it into practice

The RMA's approach to environmental management is through the principles of sustainable management and integrated management of all resources. The main difference between the RMA and other legislation in New Zealand is that it is effects-based. This means that no activities are specifically legislated against, but the actual, potential or cumulative effects are. These effects are legislated by policies, plans and objectives at three different levels (see Figure 15).

Plans and Policies

How these plans and policies interact is shown in Figure 15.

National Policy Statement- The only mandatory National Policy Statement is the New Zealand Coastal Policy Statement. Central government may set policies for matters of national significance.

Regional Policy Statement- This allows the regional councils to outline a broad direction and framework for managing the resources in their region. The Regional Policy Statement is mandatory.

The Regional Policy statement outlines the policies and objectives dealing with natural hazards; however it is often generic stating that the council will aim to avoid, remedy or mitigate natural hazards. It often does not differentiate between the different hazards that affect the region.

The district/city council only has to take responsibility for natural hazards if it is outlined in the regional policy statement that they shall. Their only responsibility is what is outlined in the policy statement. If no district authority is outlined then it automatically becomes the regional council's responsibility. Previously a regional or district plan could 'not be inconsistent' with a regional policy statement. To ensure that councils followed through on their policy statements there was an amendment in 2005 to the effect that regional and district plans must now 'give effect to' the policy statement. This means that now all policies and objectives must adhere to the policy statement.

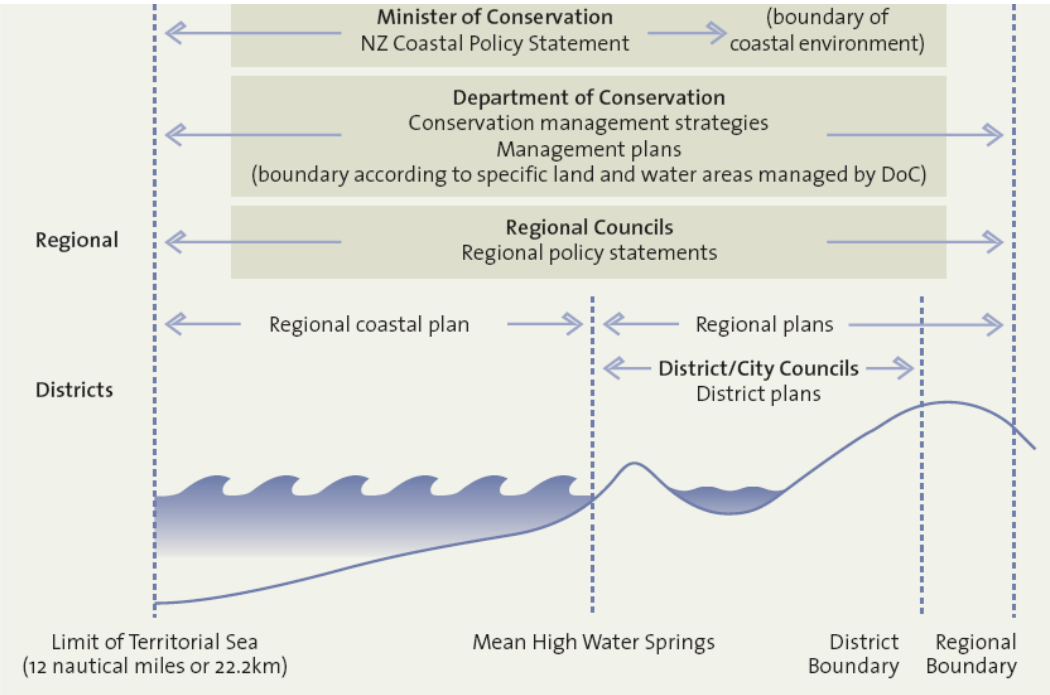

Figure 15 Hierarchies of Plans (Ministry for the Environment, 2006)

Regional Plan- The regional plan outlines the rules that will be used to control the use of resources and aims to assist the authority to carry out its function. The only mandatory Regional plan is the Regional Coastal Plan.

District Plan – The district plan outlines the rules that will be used to control the use of resources and aims to assist the authority to carry out its function. District Plans are mandatory.

Council Responsibilities

The regional and district councils have very different responsibilities which are outlined in the RMA 1991. The regional council has responsibility for the use of resources, including natural hazards. District councils have responsibility over land use and the placement of physical resources including infrastructure.

Consents

Applications for resource consents must be made under the RMA. If the adverse effects of an activity are found to be more than minor then those effects must be remedied, mitigated or avoided. If this is not possible then the resource consent will

not be granted. In some cases, consents must be publicly notified to allow members of the public to have an input into the decision making process.

Other Legislation

The RMA 1991 has ties to many other acts. Listed below are the other Acts that relate to the RMA 1991 and are relevant to this study:

- Building Act 2004
- Civil Defence and Emergency Management Act 2002
- Local Government Act 2002
- Historic Places Act 1993

The relationship between these acts and the RMA 1991 is discussed later in this chapter.

Civil Defence Emergency Management Act 2002

Background

The Civil Defence Emergency Management Act 2002 ("CDEM Act 2002") replaced the Civil Defence Act 1983 as New Zealand's disaster management legislation on the 1 December 2002. Since 1983 changes to government structures and disaster management best practice made the Civil Defence Act 1983 obsolete. The CDEM Act 2002 introduces these new structures and best practices directly into the legislation.

Differences between Acts

The underpinning themes of the CDEM Act 2002 are the 4Rs (readiness, reduction, response and recovery) and sustainable management. The CDEM Act 2002 also takes an all hazards and risk management approach, which was lacking from the previous (1983) Act. Some hazards were not envisaged in the 1983 Act such as technological failure. The other major difference between the two acts is the inclusion of public participation into disaster planning and decentralising the control towards local governments (MCDEM, 2005).

Civil Defence Emergency Management Structure

The CDEM Act 2002 specifies how civil defence management is to be run in New Zealand.

Director of Civil Defence Emergency Management - The role of the Director of CDEM is to advise the Minister of Civil Defence, identify risks and hazards of national importance, develop guidelines and standards and control resources during a national disaster.

Civil Defence Emergency Management Groups (CDEM Groups) – CDEM groups are a central component of the CDEM Act 2002. CDEM Groups comprise members of regional and local councils chaired by the Mayor or other delegated representative. The Group must prepare CDEM Group plans and manage hazards and risks within the 4R's framework (CDEM, 2005).

Each CDEM Group must also prepare a Civil Defence Emergency Management Plan, which needs to include such information as liability of local authorities for financial and other resources necessary in a disaster, the arrangements for declaring a state of emergency, and the co-ordination between other Groups. CDEM Groups must consult with the public over their group plans and allow time for submissions to be made. The plan must be reviewed every five years. A hazard register is required to compare disasters and list disaster that have occurred on properties to help prevent them reoccurring.

Emergency Declarations and Powers

State of Emergency- under the CDEM Act 2002 the Mayor (or delegated representative) or Minister may declare a state of local emergency. The Minister may declare a state of national emergency. Declared emergencies have a duration of 7 days. This time period may be changed as needed.

Emergency Powers- emergency powers entitle CDEM groups and controllers to:

- Close roads/ restrict access
- Remove/secure dangerous structures/materials
- Provide rescue, first aid, food, shelter etc
- Provide essential supplies and regulate traffic
- Dispose of dead persons and animals
- Advise the public
- Provide equipment

- Enter or evacuate premises
- remove vehicles
- request equipment/materials and assistance

Other Legislation

The CDEM Act 2002 relies on and works in partnership with other acts:

- Building Act 2004
- Resource Management Act 1991
- Local Government Act 2002

Other Acts also work with the CDEM Act 2002. However, these acts are not of significant relevance to this study.

Local Government Act 2002

Background

In 1989, local government was reformed significantly with the amalgamation of 700 councils into 12 Regional Councils and 73 District or City councils. The main statutes of local government changed again when in 2001-2 Parliament passed three new acts – Local Electoral Act 2001, Local Government (Rating) Act 2002 and Local Government Act 2002 ("LG Act 2002"). These new Acts clarified councils' responsibilities with other Acts (Resource Management Act 1991, Biosecurity Act 1999 and others). The new Acts also gave the council more flexible powers and tools to fulfil their obligations.

Roles and Responsibilities

Regional and District councils have separate responsibilities under the Local Government Act 2002 and the Resource Management Act 1991.

Regional Councils – the Regional Council's responsibilities include:

- Sustainable regional well being
- Managing the effects of using fresh water, land, air and coastal waters, by developing Regional Policy Statements and by issuing resource consents
- Manage rivers, mitigate soil erosion and flood control
- Regional emergency management and civil defence preparedness

- Regional land transport planning and contracting passenger services, harbour navigation and safety, oil spills and other marine pollution
- Natural hazard management

District/ City Councils - the District Councils' responsibilities includes:

- Sustainable District well being
- Provision of local infrastructure, including water, sewage, Stormwater and roads
- Environmental safety, health, district emergency management and civil defence preparedness, building control, public health inspections and other environmental and health matters
- Controlling the effects of land use (hazardous substances, natural hazards and indigenous biosecurity) noise and effects of activities on surface of lakes and rivers (Ministry for the Environment, 2006)

Long Term Community Council Plans - The Long Term Community Council Plan (LTCCP) outlines community direction and finances over the next 10 years. The plan is required to be updated every 3 years. It outlines the goals and objectives for the community and describes the activities of the council and is required to give the public the opportunity to participate.

Other Legislation

The most relevant Acts that relate to the LG Act 2002 for the purposes of this study are the CDEM Act 2002, the Building Act 2004 and the RMA 1991.

Building Act 2004

Background

The Building Act 2004 replaces the Building Act 1991. The 2004 Act was introduced to improve building controls and practices, which had led to building problems ("leaky homes"). It establishes more licensing and accreditation for construction workers. The new Act also provides more protection for homeowners and introduces mandatory warranties.

Another reason for updating the Building Act 1991 was to align the new Building Act more closely with the RMA. The purpose of the Building Act is to ensure the safety of people using buildings, ensure that buildings are designed so people can escape from fire, and

ensure buildings are designed and constructed and used in ways which promote sustainable development (Building Act 2004: Section 3).

Plans and Policies

The Building Act requires building consents to be applied for when building a new structure or renovating an existing structure. Some buildings may require both a building consent and resource consent. Under the Building Act 2004, building consents now expire if work has not started within 12 months of the consent being issued.

Under the Building Act 2004, sections 30-39, a Project Information Memorandum (PIM) can be applied for. This document shows information on the property that is useful if building a new structure or adding an extension to an existing structure. A PIM includes information on the location of services, special land features including natural hazards, any Historic places or Department of Conservation protection orders and any consent that may need to be applied for.

The Building Code 2004

The Building Code is a schedule to the Building Act and is performance- and National Standard-based. The purpose of the Building Code is to outline the functional requirements for buildings and the performance criteria a building must comply with for its intended use (Building Act 2004: Section 16). The existing building code is currently being reviewed to align itself with the new purposes of the Building Act 2004.

Currently under review in the building code are the safety objectives, particularly the structural safety objectives. Under *Safety Objective 1- Loss of structural integrity, stability and support* it is proposed to include tsunami, coastal erosion and volcanic eruption design and construction performance criteria to mitigate the effects of these hazards.

Under the Building Code structures should have 90% chance of surviving their expected lifetime. This is usually 50 years for most structures. Structures should also be built to survive certain events. Depending on the hazard this ranges from a 500 year return period event to a 50 year return period. However, structures, which are

essential for emergency operations or are public buildings, should be built for a return period of 2500 years.

Historic Places Act 1993

Background

The purpose of the Historic Places Act 1993 ("HP Act 1993") is to protect places of significant historic values while still giving landowners property rights. The HP Act 1993 was intended to incorporate the perseveration of historic places into the RMA 1991 framework.

Local Government Official Information and Meetings Act 1987

Under Section 44a of the Local Government Official Information and Meetings Act 1987, the district or city council must compile a Land Information Memorandum (LIM) report. The report details information that the council holds about a property. Most people apply for a LIM report when they are considering buying a new property. A short list of what is involved in a LIM report is detailed below, however a more thorough account can be found in Appendix A.

A LIM report contains information on:

- Planning- Zoning, consents, proposed changes to zoning
- Building- consents and permits, building warrant of fitness
- Health- Liquor license, registered premises
- Engineering- Flooding and Inundation, erosion, subsidence, falling debris, slippage, alluvion, fill
- Rates- Land value, annual rates and water charges

Other information can be included in a LIM report at a council's discretion.

Interaction of Legislation and Disaster Management

The two major Acts that control mitigation of natural hazards are the RMA and the Building Act 2004. These Acts work together by making policies to control the effect of structures on the environment and the quality of these structures.

The RMA is concerned with the effect an activity will have on the environment if it is exposed to natural hazard. There are multiple sections of the RMA that refer to natural hazards. Sections 30, 31, 35, 45, 58, 59-68 and 72-76 (for detailed outline see Appendix A) outline the responsibilities regional and district councils have to control land use to avoid or mitigate natural hazards. In addition, these sections outline how regional and district plans should be prepared with the acknowledgement of natural hazards.

Sections 106,108,220 and 229 consider the effect that natural hazards have on subdivisions. Therefore, a subdivision cannot be built on an area of land that is at risk from natural hazards. These sections also provide for esplanade strips and reserves to mitigate natural hazards. The RMA 1991, Section 2 defines natural hazards as:

'*any atmospheric or earth or water related occurrence (including earthquake, tsunami, erosion, volcanic and geothermal activity, landslip, subsidence, sedimentation, wind, drought, fire, or flooding) the action of which adversely affects or may adversely affect human life, property, or other aspects of the environment'*.

Sections 329-330B provide for work to be undertaken during a time of emergency without resource consent in accordance with the CDEM Act 2002. An example of what would be possible under this section would be equipment needing to enter the bed of a river or lake for emergency flood bank repair (Elizabeth Lambert, pers comm. 2007). Under this section, the work could be done without resource consent. However, the council needs to be notified of this activity within 7 days. If an adverse effect results from the emergency works then resource consent must be applied for within 20 days.

Sections 71 to 74 of the Building Act deal with building structures on land subject to natural hazards.

Natural hazards are defined in this section as:

Erosion (including coastal erosion, bank erosion, and sheet erosion):

- Falling debris (including soil, rock, snow, and ice):
- Subsidence
- Inundation (including flooding, overland flow, storm surge, tidal effects and ponding):
- Slippage.

A building consent must be refused if:

- the construction or alteration of a building occurs on land subject or likely to be subject to one or more natural hazards
- the building work is likely to accelerate, worsen or result in a natural hazard on that land or any other property.

However if adequate provision has or will be made to:

- protect land, building work or other property from natural hazards
- restore any damage caused by the building work

then the building will be allowed to go ahead.

The CDEM Act 2002 and the RMA 1991 use the principle of sustainable management as part of their purposes and define it as:

- sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety while—

a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and
b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and
c) Avoiding, remedying or mitigating any adverse effects of activities on the environment.

However, the Building Act 2004 also uses the principles of sustainable development as part of its purpose. The Building Act 2004 does not define sustainable development; therefore a general definition of sustainable development can be used. Thus, sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Report 1987).This shows that while the Building Act 2004 is supposed to have aligned with other current legislation the wording used is contrary to the CDEM Act 2002 and the RMA. By using sustainable development in place of sustainable management, the Building Act is showing that development is still its focus.

The RMA and the HP Act 1983 and the Building Act 2004 work together by ensuring that historic buildings are not demolished unnecessarily.

There are, however, some parts of these acts, which do not work well together. The RMA approach is to let regions and districts decide what issues are relevant for them and plan accordingly. This is in direct contrast to the Building Act 2004, which through the Building Code requires national standards.

Effects of Legislation on Recovery

The current legislation will greatly affect recovery in New Zealand, as it is the rules outlined through these statutes that will still apply during a recovery phase unless government suspends them. Recovery will take place after the state of emergency has been lifted therefore any special activities that are allowed during a state of emergency are revoked.

District and city plans contain rules and objectives a district or city will enforce to control natural hazards.

An example of these rules is shown in Box 1 from the proposed City of Napier District Plan, Chapter 62 Natural Hazards:

Box 1Example of Objectives, Methods and Policies in District and City Plans (Proposed City of Napier District Plan., 2007)

Objective 62.3
To manage the effects of natural hazards on land uses throughout the City.
This objective relates to Issues 62.2.1 and 62.2.2.
Methods
(1) District Plan Rules.
(2) Establishment of a Hazard Register and provision of known hazard risk information collected and collated by the Council in all LIM's and PIM's.
(3) Identification of known hazards on the Council's GIS database.
(4) Physical works such as the beach renourishment scheme, or the provision of pumps to mitigate floodwaters.

Objective 62.4
To control the effects of land uses and development on areas subject to natural hazards throughout the City.

Policies
In order to achieve this objective, the Council will:
62.4.1 Direct development away from areas known to be subject to natural hazards.
62.4.2 Control existing development in areas subject to natural hazards.
62.4.3 Monitor the state of the natural hazard.

These are usually specific to the hazards that affect a certain area. Often these rules are generic for major hazards but very specific for more frequent events like flooding. Most rules and objectives for other natural hazards aim to avoid, remedy or mitigate. Many of these rules are in place because much of the development already occurs in places at risk to natural hazards.

To regulate existing development and ensure that future development does not occur in hazardous areas the Building Act 2004 and RMA 1991 are invoked. However just as this legislation is appropriate for existing and future land use it may not be appropriate when changes are to be made during recovery. These rules should be reviewed for a time of recovery so that appropriate changes can be more effective.

Any new legislation that occurs during recovery needs to be able to work with the existing acts. Often moratoriums on rebuilding are used to prevent rapid rebuilding

and give time for new regulations to be thought through and planned. If these new regulations were partially thought through beforehand, then rebuilding could begin earlier. These changes may be a combination of things such as land use changes, changes to the building code and different architectural styles.

Changing the district or city plans can be a long, slow process. The group or person seeking a plan change needs to file a detailed assessment of environmental effects, which takes additional time (James Mineham, pers comms, 2007).

Regional plans are generally slightly different. A Coastal Plan is mandatory so all coastal hazards are covered here. Coastal hazards are also covered in natural hazards sections of Regional Plans as well as the natural hazards sections of city and district plans if the region is coastal. Therefore, coastal hazards receive higher coverage than other hazards. Regional Plans contain rules and objectives to avoid, remedy or mitigate natural hazards. They may also include coastal hazards zones, which have additional rules. However, there are generally no provisions to change any rules during a recovery or response phase.

This kind of approach towards managing natural hazards has both negative and positive features. As coastal plans are mandatory, coastal hazards are usually dealt with more thoroughly than other hazards. However, the treatment of the coast may give the impression that coastal hazards are of greatest importance, when there may be another hazard, which may have greater or equal risk, except that it is dealt with differently as it is not in the coastal zone.

One positive feature is that regions can plan the best way for them to deal with each hazard instead of following standards that may not work or be applicable to the particular region, this follows on to recovery changes. Recovery changes in local plans, which have been developed specifically for a region, may not be suitable for the whole country, for example, recovery changes related to volcanic hazards may not be applicable in the South Island of New Zealand where they are no currently active volcanoes.

PIMs and LIMs could have more of a role in recovery planning especially for existing structures. Recovery plans could be added to particularly vulnerable properties' LIMs, stating changes that will need to be completed if a disaster occurs. The changes will have to be relative to the amount of repair that is needed. PIMs could contain more information about zoning changes likely to occur during recovery; depending on what the current zone is these changes may be able to begin before a disaster occurs which could reduce the effects.

The Building Code can facilitate changes during recovery. These changes should include any updated technology that may have been developed especially regarding structural safety or other changes such as floor heights or building materials.

The HP Act 1993 needs to work in with any changes too. Damaged historic buildings may not always be built to required standards. Therefore retrofitting of historic buildings should take place when possible. Care should be taken during recovery that historic buildings are not demolished unnecessarily.

The RMA needs to be carefully considered for environmental problems that may occur as a result of a disaster. There is usually a massive amount of debris from the damage caused by the disaster. Places to dispose of debris need to be carefully considered. Many places around towns and cities are not suitable for rubbish disposal and many existing dumps may not have the right facilities or space to deal with large amounts of debris (Elizabeth Lambert, pers comms, 2007). Before a disaster occurs a landfill for disaster-related material should be selected and feasibility study done so that it can be used soon after the disaster for disposing of debris.

Other problems will inevitably occur as a result of the consent process required by the RMA and the Building Act 2004. It is likely that the council staff will not be able to cope with the amount of consents and other problems that will arise from a disaster. A way to streamline consents may be initiated especially those consents which require a building consent and a resource consent for building work. As this process will take up the time of two departments, there will also need to be inspection of the building work and depending on the consent there maybe a monitoring condition as part of the resource consent.

It seems that the LTCCP is currently the best plan to incorporate recovery measures. However it is still not perfect. The LTCCP outlines the development that the community has approved for the next ten years. It also outlines the finances of each council department. Recovery planning could be incorporated in this plan in each section which shows how this department will rebuild after a disaster. This would allow for public participation on recovery matters and it would be updated regularly. However this would not necessarily be an effective plan if a disaster did occur, as this kind of plan may not include important recovery factors such as temporary housing or business premises. In addition these plans would be general objectives rather than specific rules and would rely on the discretion of the councils to include and prepare recovery plans.

Conclusions

- Several different kinds of legislation relate to disaster management in New Zealand; much of the legislation integrates different environmental systems and has been designed to work with other statutes.
- The three main statues (RMA 1991, Building Act 2004 and CDEM Act 2002) that relate to disaster management involve to some degree mechanisms for reduction and preparedness of risks.
- However, while some of the statutes have provisions for the response phase of the disaster none of them have the capabilities to deal with the unique situation that will occur during the recovery phase of a disaster.
- Measures can be taken to change these shortcomings in the legislation, such as alternative rules in district and regional plans for a time of recovery, land use changes, changes in applications for resource and building consents and changes to the building code.
- Additional information and changes to how PIMs and LIMs are used could also give members of the public more understanding and information about the natural hazards they are exposed to on their property.
- Changes to legislation would be more effective during recovery and would speed up recovery if they were planned before the event. This would make

* sure that the changes would actually work instead of being rushed through in a time of disaster.
* At this time the best plan to include recovery plans would be the LTCCP, however this is not designed as a recovery plan and while recovery plans included in the LTCCP would be better than no plan it is still not ideal.

Chapter 5 - Recovery Plan Templates

Introduction

The concept behind these recovery plans is that they include enough information to be used for any type of large scale disaster in any town or city in New Zealand. A series of plans have been developed to be used in conjunction with each other. They have been kept simple so that they can be adapted to a specific situation for a specific place. A pre-event planning component has been combined with a post event plan. A critical factor of recovery is communication between the agencies involved in recovery. Without communication, recovery of an area will not be as swift or effective.

Components of Pre event planning

Pre event planning combines planning actions to be taken before the disaster with actions to be taken after the event. Figure 16 shows the components of pre event disaster planning. A community is made up of four environments: built, natural, economic and social. These environments interact with each other and determine the amount and type of disaster management to be used. In New Zealand disaster management there are different agencies which manage different parts of each environment.

For example part of the social sector is managed by Work and Income New Zealand, Housing New Zealand, Victim Support, Salvation Army and the Red Cross to name a few.

All of these agencies need to have contingency plans so that they can operate efficiently during a disaster. They need to ensure that they know what the other agencies are doing to avoid duplications in services. This follows on to businesses that need to plan and insure for disasters. This includes insuring for damage to premises, loss or damage to stock and loss of earnings (Nigel Simpson, pers comms, 2007).

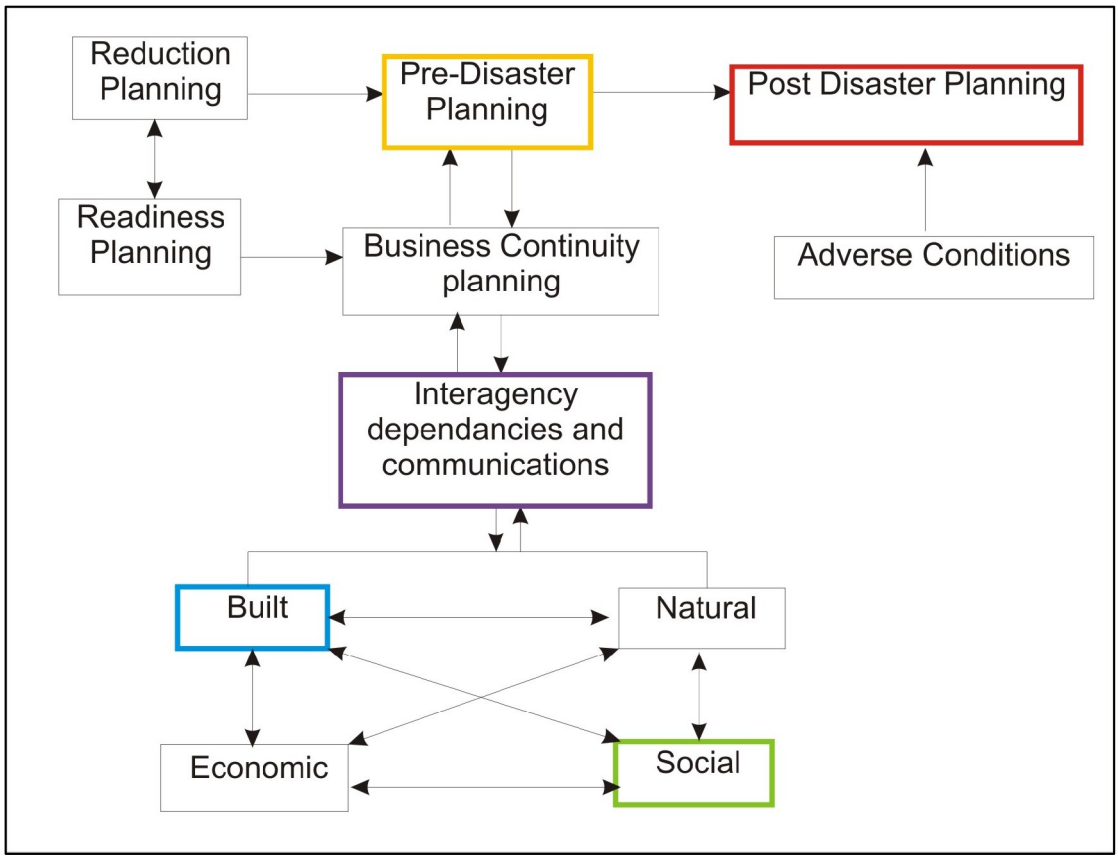

Figure 16 Components of Recovery Planning

Disaster management in New Zealand is governed by the 4 R's (reduction, readiness, response, recovery). Therefore all agencies, businesses and environments need to engage the concepts of risk reduction and readiness in preparation for a disaster.

All of the components are incorporated in to a pre disaster plan which outlines matters that can improve the post disaster situation to increase resilience and sustainability. This follows on to the post disaster plan which is used after an adverse event and uses what was considered in the pre disaster plan, however it may be necessary to modify parts of these plans.

In Figure 16 each coloured box represents a plan made during this study which is discussed further below.

Built Environment

The built environment plan shown in Figure 17 shows pre event and post event actions that need to happen, collectively through the government and by different social groups throughout the community. Pre event actions include risk reduction measures such as retro fitting structures and encouraging people become insured.

Post event these same actions are assessed and the measures that were planned pre event are included in the rebuilding phase.

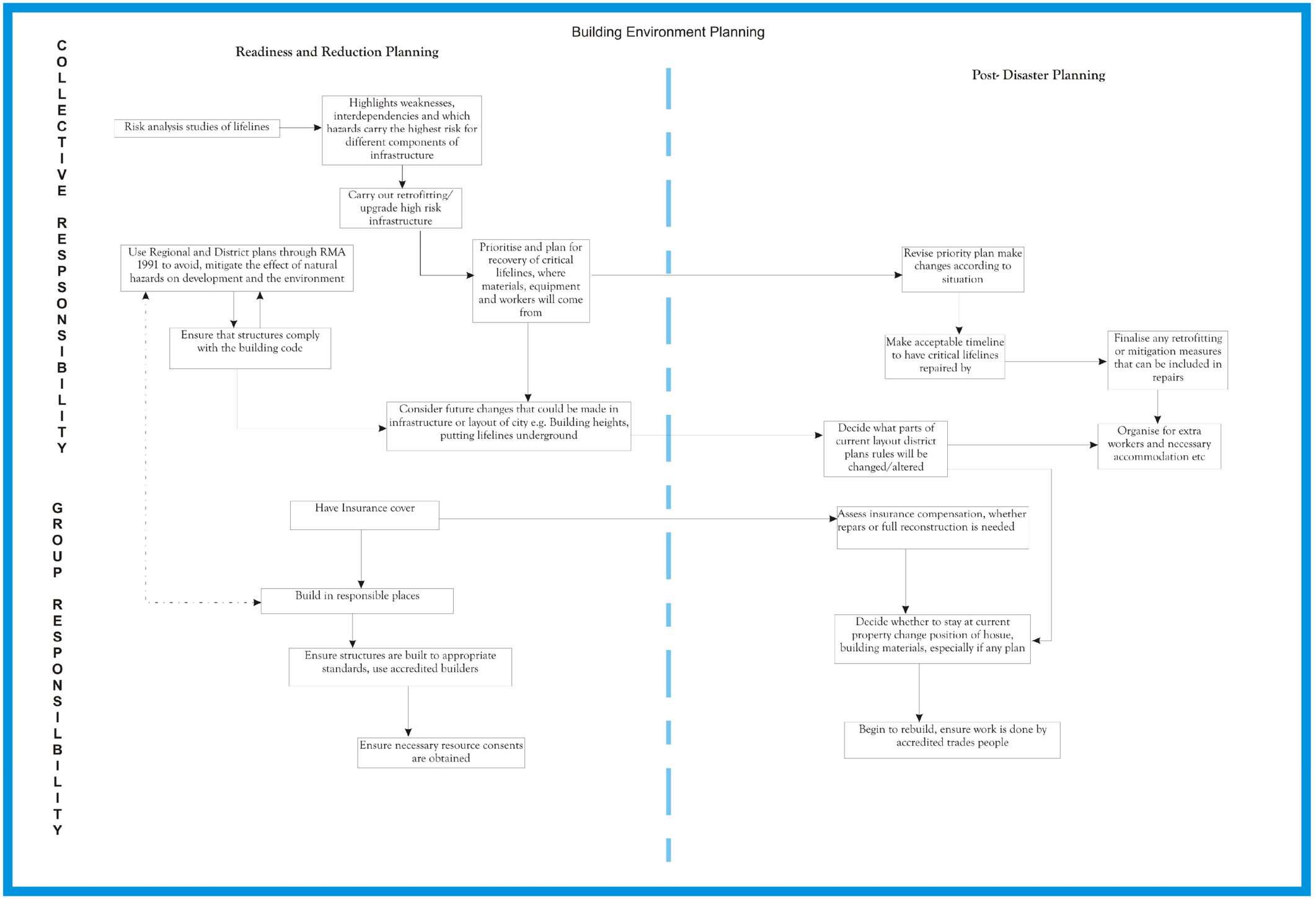

Figure 17 Built Environment plan

Social Environment

The social environment along with the built environment interacts and is affected by the other environments. Figure 18 shows the social environment, pre event collective responsibility is with the agencies that will respond during the disaster ensuring that they know what their responsibilities will be and making sure they have the capacity to fulfil their duties. The group responsibility lies with businesses and social groups in the community for example families who should ensure that they are prepared by putting together survival kits and reducing risks by making their homes 'quake safe' (EQC).

After the event the agencies need to ensure effected people's needs are met and families need to follow their pre event preparations.

Pre event Recovery Plan

The pre event recovery plan (Figure 19) outlines vulnerabilities often needing attention before a disaster. It also allows for post disaster changes to be thought through prior to the event, such as changes to land use, architecture styles and areas available to development, so that the time taken for legislation to be modified to allow the changes to be made will be reduced. By identifying vulnerabilities before a disaster occurs time is available to reduce these vulnerabilities to decrease the damage from a disaster.

A path through the plan has been highlighted by yellow boxes shown in Figure 19. Following through the boxes in number order the contents of the boxes are described further below:

- **Box 1:** These are the four environments that make up a community, each environment needs to be considered at every step through the diagram, and whether the effects from one environment will flow on to another.

- **Box 2:** All possible effects of disasters need to be considered for environment. The vulnerabilities and resiliencies of these environments likely to affect a

region needs to identified, so they are covered in the plan. The scale of these impacts needs to be identified; a drought for example may severely affect a regions economy but will not damage houses.

- **Box 3:** After these vulnerabilities have been identified a number of mitigation strategies will be available, it will be possible to implement some as part of maintenance, however it may not be possible to include mitigation measures for all hazards, as often building designs to mitigate tsunamis may increase earthquake risk. Other mitigation methods may only be implemented after a disaster occurs.

- **Box 4:** considers the mitigation measures that can only be implemented once a disaster has occurred. Before the disaster occurs planning of these initiatives should be undertaken. Stylized streets can be planned for how these measures should be implemented. New measures to be implemented may range from widened streets, height restrictions, land use change or services put underground.

- **Box 5**: A short term goal which should be decided upon before the event that is an acceptable time to have services restored. To be successful this will probably have two phases. The first aim should be to have services running although some parts of the service may have temporary repairs, the next phase is to completely repair all services to 100% efficiency. As these services are repaired and become more reliable it will be possible for businesses to open. For this reason businesses should be encouraged to develop their own contingency plans to prepare for a post disaster situation. This includes insurance for lost earning, damage or loss of stock and damage to buildings or equipment and also emergency equipment such as back up generators for lighting, water or machinery.

- **Box 6**: Once this plan is finalised then the plan should be reviewed and updated over an agreed timeframe by all agencies involved. This is so any legislation changes, technology changes or community changes can be integrated into the plan. Any mitigation measures that may have been

accomplished since the last review can be evaluated and new mitigation measures discussed.

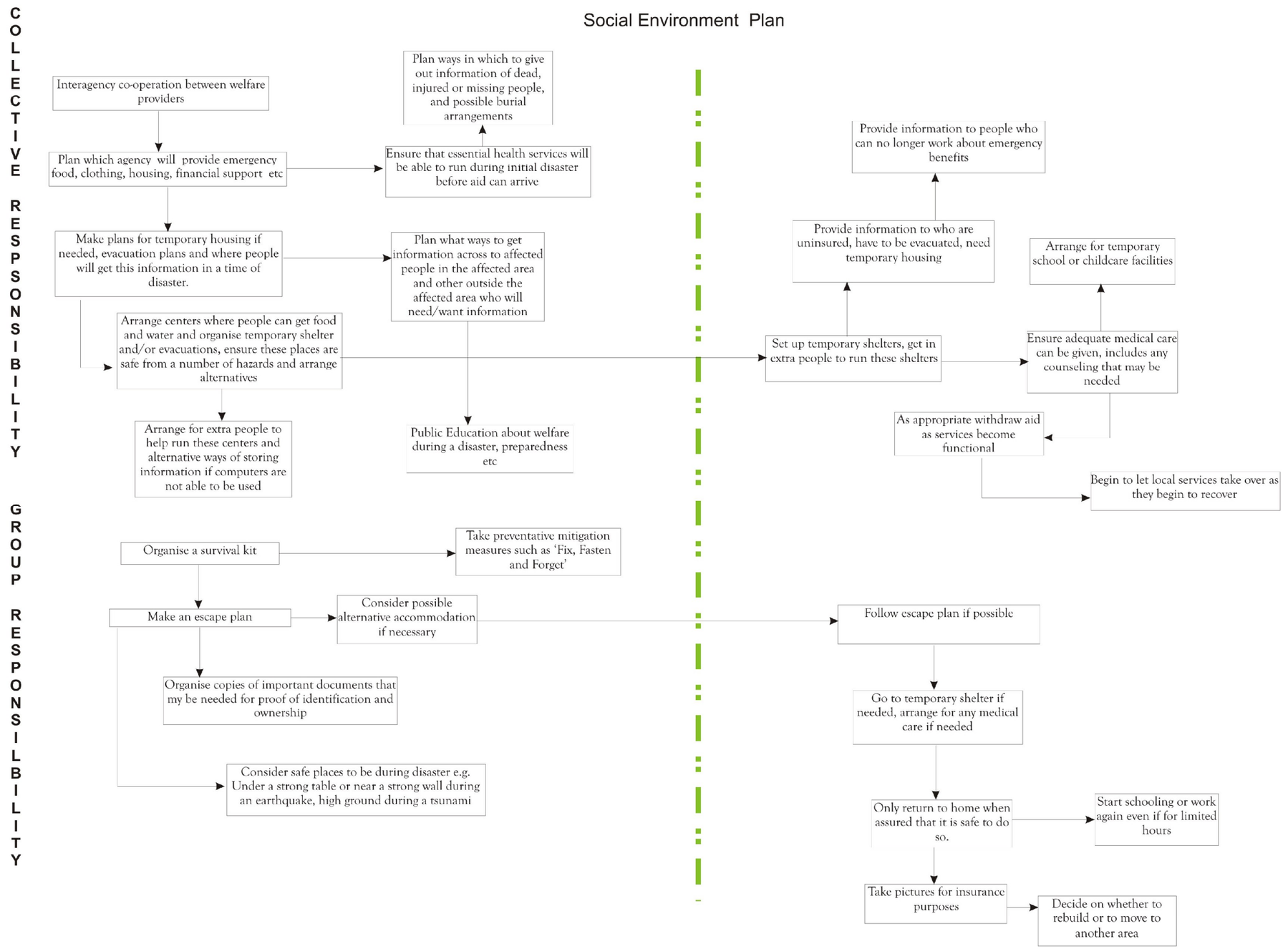

Figure 18 Social Environment Plan

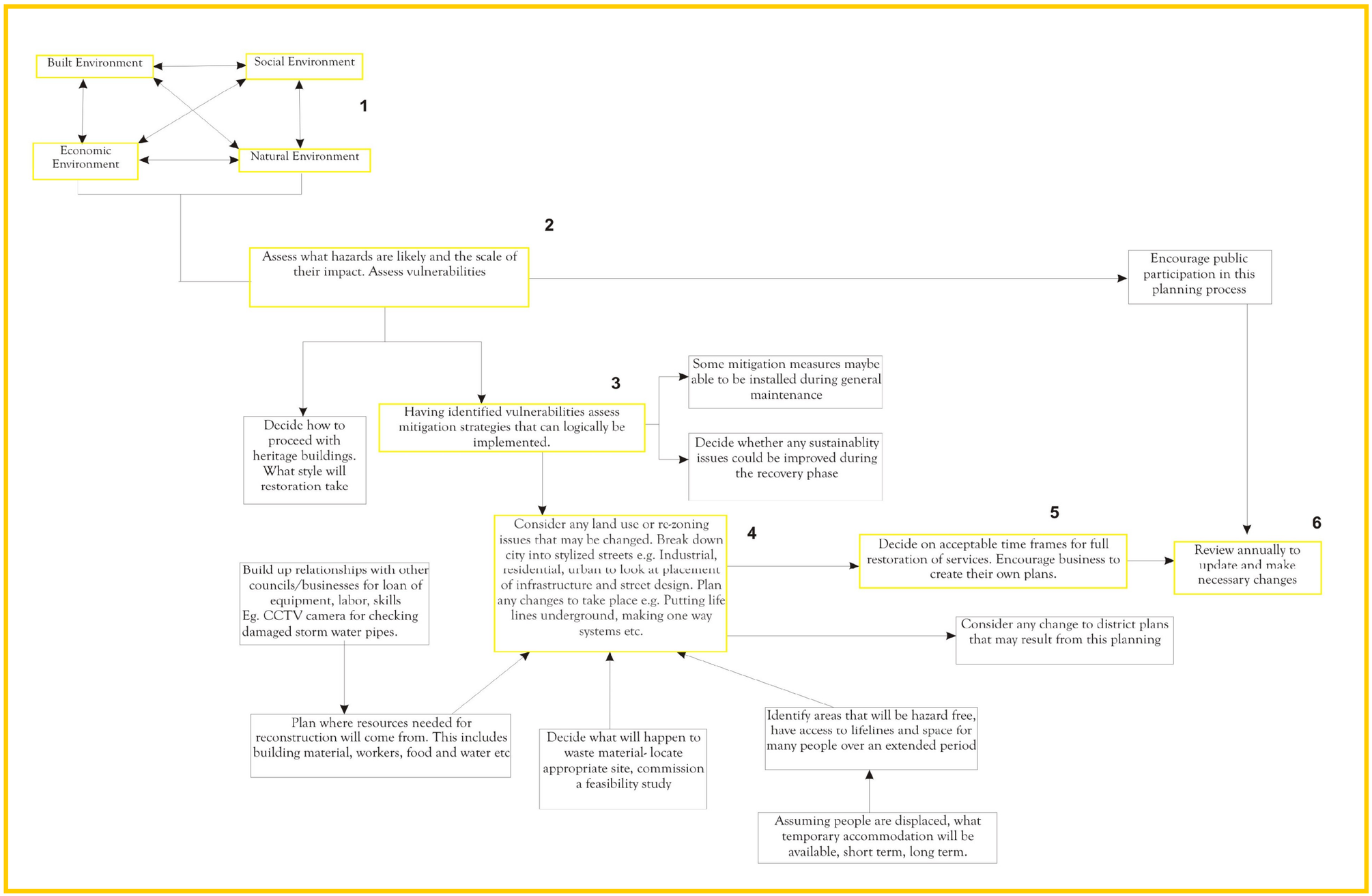

Figure 19 Pre Disaster Recovery plan

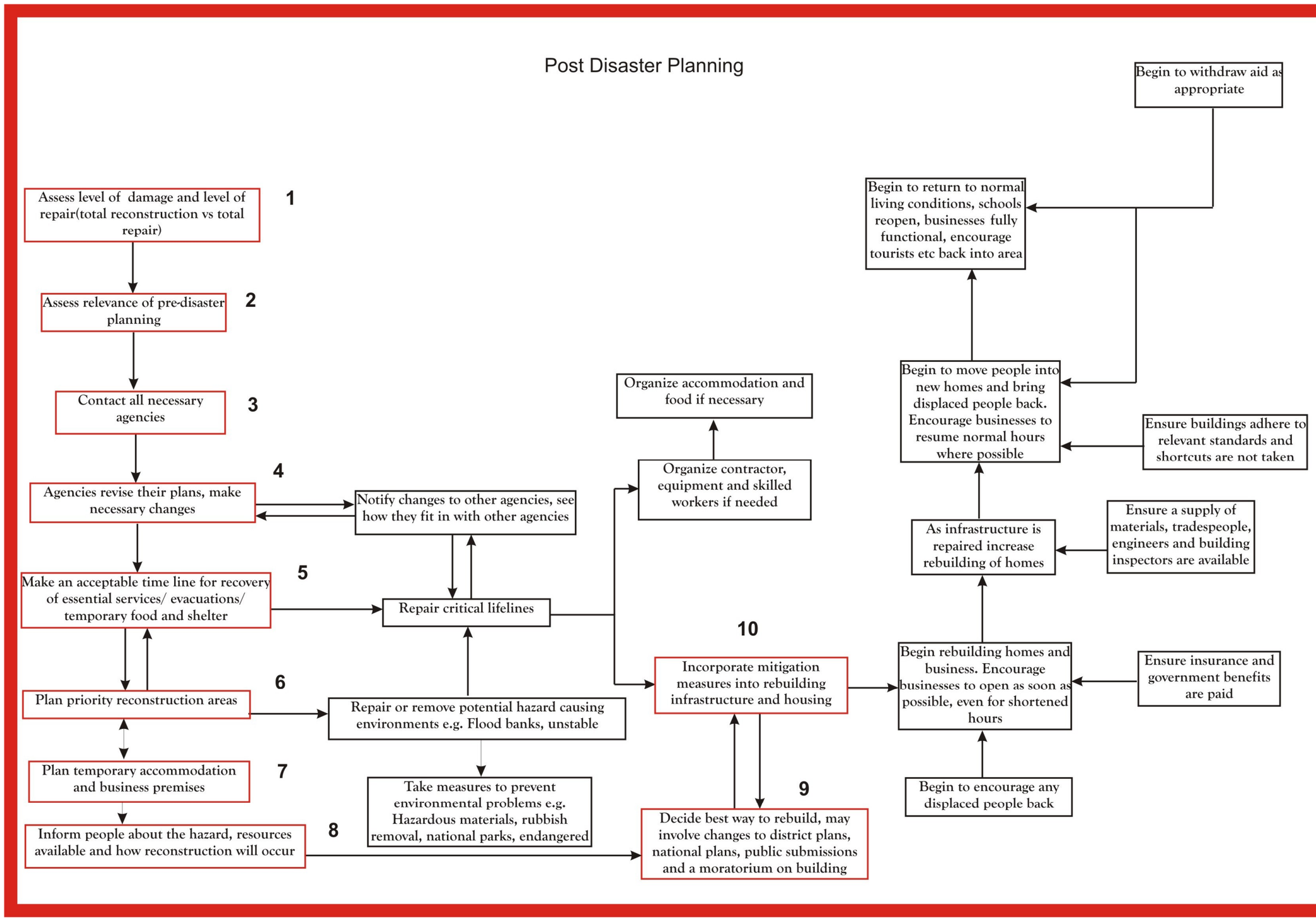

Figure 20 Post Disaster Recovery Plan

Post-Disaster Recovery Plan

The post disaster recovery plan outlines the actions of the pre disaster plan that will be carried over to the post event situation. There are activities that can not be finalised until the disaster has happened, however most of these things can be partially planned before the event leaving more time for any unexpected events to be assessed.

The post disaster plan which is shown in Figure 20 follows a path in number order through the plan, further information from each box is described below:

- **Box 1**: The first action after a disaster is to assess the level of damage, what percentage of damaged buildings and infrastructure can be repaired and what needs to be demolished and rebuilt. It may not be necessary to rebuild all of the buildings that have been damaged or they may be rebuilt in a different way.

- **Box 2**: The next action is to look at the pre disaster plan and decide what parts of the plan are applicable to the situation. There may be some decisions which are not relevant to this disaster or damage occurred that was unexpected.

- **Box 3**: To recover from the disaster the agencies that will be involved in the recovery need to be contacted. Depending on the disaster some agencies may not be needed. For example a disaster may occur in an industrial area so a large number of people will not need temporary accommodation as their houses are undamaged.

- **Box 4**: Each individual agency will need to evaluate their post disaster plan. They may need extra staff to cope or extra equipment and materials for repairs could be needed which might delay repairs.

- **Box 5**: The timeline for restoration of services estimated in the pre disaster plan should be assessed as to its feasibility. The timelines will cover a range of

operations from acceptable time for lifelines to be repaired to evacuations to preparing temporary housing for displaced people.

- **Box 6**: However there may be some areas that need attention over others. This will constantly be reassessed as the recovery continues and timelines will be reviewed as the need arises for example areas with live wires or leaking water mains will take precedence over areas where damage is not as severe (Hawke's Bay Lifelines Group, pers comms, 2007).

- **Box 7**: It is likely that no matter what the disaster that some people will need temporary accommodation. Over the short term they may be able to stay with friends or family however areas where temporary housing can be set up should be planned before hand. These areas need to be safe from other types of disasters as the construction will not be as strong as a permanent dwelling. Businesses may also need temporary premises so that business can continue during the rebuilding.

- **Box 8**: People affected by the disaster will need to be informed about the disaster, the planned recovery and ways that they can be involved in it. Other information such as health and safety messages, funding resources and reconstruction areas need to be publicised so people who may have evacuated and people still in town can be informed.

- **Box 9**: Leading on from informing people about recovery is deciding the best way to rebuild. This may include changing the district or city plan in terms of zoning and land use or rules about building height and styles. National standards may be changed or introduced, an example of this is the Building Code. The public should be informed and able to participate to a certain extent. However the decision process should have limits to the amount of time for participation and appeals so as not to delay recovery any longer than necessary

- **Box 10**: Interconnected with the policy changes will be the mitigation measures which are chosen to be implemented. The mitigation measures should not be limited to the particular disaster that just occurred, mitigation measures for other disasters should be included where there is the potential to increase resilience as much as possible

Communication and Interdependency

In New Zealand the co-ordinated incident management system (CIMS) is used by agencies to co-ordinate response and recovery activities (MCDEM, 2006). All agencies that work with Civil Defence, local authorities and Civil Defence groups are encouraged to adopt CIMS as their management system. The reason for the use of this system across all agencies and groups involved in emergency management is for co ordination between all groups and consistent and effective response to and recovery from disasters. Common terminology is used and resources shared. Therefore during a disaster communication between different agencies and groups should be effective.

Private and government owned agencies make commitments to help in a disaster situation. These agencies deal with similar situations as part of their normal functioning and are therefore are appropriate choices during a disaster as they already have the needed experience. For example the New Zealand Police continue to be responsible for law and order during and immediately after a disaster. However, as the police from the region affected may not be able to cope with the situation, as was shown in New Orleans where police deserted their positions (Brinkley, 2006; Department of Homeland Security, 2006), additional police will need to be brought into the area, which may stretch the resources else where. This is true for most of the other agencies involved. They need to fulfil their emergency responsibilities along with their day to day running.

Communication between each group is important as agencies need to know what other agencies and groups are doing during and after the disaster. For example emergency services (police, ambulance and fire) will need to know the state of roads

for search and rescue and therefore will need to contact Transit and the district councils for road updates.

Agencies within certain sectors (built, social, economic and natural) have different responsibilities and need to communicate internally and with other agencies externally. However external coordination and communication between different sectors also needs to occur. The majority of communication between different agencies is because they are dependant on each other for certain functions to be completed. Therefore a potential problem during recovery is the break down of communications between different agencies.

Shown below in Table 4 is a dependency matrix for the built environment, the list of agencies is by no means exhaustive. Agencies were assigned a value from 1-5, with 1 being low level of dependence and 5 high level of dependence, based on how much communication would need to occur between agencies. Matrixes for other environments can be found in Appendix B. The least dependant of the agencies involved in the built environment is federated farmers (highlighted in green), while the agency that has the most dependencies is the district council (highlighted in red). This is because the district council has many roles and responsibilities ranging from building and policy to roading which are all components of the built environment. This highlights a weakness that may occur during recovery where the district council may not be able to fulfil its role as offices may be damaged, documents lost and staff killed or injured which may make it more difficult to manage other agencies. This is a possibility for any agencies involved. If this were to happen then staff and equipment from other regions would have to cover the affected area. This may cause additional problems with people unfamiliar to the region becoming decision makers.

These problems may flow on to other regions of New Zealand as agencies may need to call workers in from different centres to fill staff gaps in the affected region. Welfare agencies that deal with benefits may find that the additional information from disaster affected people may cause delays or problems in other centres. Therefore all systems need to be checked thoroughly before a disaster to ensure that the rest of New Zealand can still function effectively.

From the building environment matrix a lifelines dependency matrix has been developed using the same scale. Lifelines as the name suggests, are essential for day to day life. Lifelines are essential during recovery as power and water are needed for private dwellings but also for a wide range of uses such as, industry, running sanitation systems, water purification and banking. Many lifelines have a high dependency on each other for instance many pipeline lifelines are laid under roads, some lifelines rely on others to run for example water pumps rely on electricity, as shown in Table 5.

Civil Defence has the highest level (highlighted in red) of dependence on lifelines. This stems from the organizational role that civil defence play in coordinating recovery and needing to know what is functioning so that alternatives can be supplied to people who relay on the resources carried by the lifelines. The least dependant are highlighted in green.

Table 4 Built Environment matrix showing interdependencies between groups

dependant on → / ↓	Lifelines	District Council	Engineers	Architects	Building Inspectors	Consents Officers	Tradesmen	Planners	Federated Farmers	Local Business
Lifelines		5	5	3	4	4	4	5	3	4
District Council	5		5	5	5	5	3	5	4	5
Engineers	5	4		4	5	4	5	4	2	3
Architects	2	4	5		2	2	2	3	1	2
Building Inspectors	3	5	5	3		5	4	4	2	3
Consents Officers	3	5	4	3	5		4	5	3	3
Tradesmen	3	2	3	2	4	3		2	2	2
Planners	3	4	2	4	3	3	1		2	4
Federated Farmers	3	4	2	2	3	4	2	3		5
Local Business	4	5	2	4	4	5	2	4	3	
Total	31	38	33	30	35	35	27	35	22	31

The interdependency of lifelines can create numerous vulnerabilities (Hawke's Bay Engineering Lifelines Group, pers comms, 2007). For example when roads and water

supply are damaged it is difficult to get trucks to transport emergency water sources to people in need and it can also be difficult to get trucks and equipment into the area that need repairs, in addition if the water mains are under roads then the need to be fixed before the road, leaving a complex problem to solve. Therefore it is important to plan for an event before it occurs so that disruption to these services can be kept to a

Table 5 Example of Built Environment interdependencies- Lifelines Group Matrix dependencies

dependant on → / ↓	Civil Defence	Transit	**District Council:**	Local Roads	Drinking waster	Waste water	Storm water		Tranzrail	Port	Airport	Local electricity provider	Gas providers	Oil Providers	Telecom	Cell phone providers	Radio Broadcaster	**Regional Council:**	-flood protection
Civil Defence		5		5	5	5	5		3	3	3	4	4	4	5	5	5		5
Transit	5			5	3	3	3		3	4	4	5	5	5	5	2	2		4
District Council:																			
-Local roads	5	5			3	3	3		3	2	3	3	3	3	3	3	3		3
-Drinking water	5	3		3		4	4		2	1	2	4	3	3	2	1	1		2
-Waste water	5	3		3	3		4		2	3	3	4	3	3	2	1	1		2
-Stormwater	5	3		3	3	3			2	3	3	4	3	3	2	1	1		2
Tranzrail	4	5		4	3	3	3			5	3	5	4	4	3	3	3		3
Port	4	4		5	3	4	4		5		3	5	5	5	4	4	4		3
Airport	4	5		5	4	3	3		3	3		5	5	5	5	5	5		3
Local electricity provider	5	5		5	3	3	3		5	5	5		3	3	5	4	4		2
Gas providers	5	4		3	2	2	2		2	5	5	3		3	4	4	2		3
Oil Providers	5	4		3	2	2	2		2	5	5	3	3		3	2	2		3
Telecommunications	5	5		5	1	1	1		4	5	5	5	2	2		3	3		2
Cell phone providers	5	5		5	1	1	1		4	5	5	5	2	2	4		3		1
Radio broadcaster	5	3		3	1	1	1		5	5	5	5	3	3	5	5			5
Regional Council :																			
-flood control	5	5		5	3	3	3		4	4	4	2	2	2	2	2	2		
Total	72	64		62	43	41	42		49	58	58	62	50	50	54	45	41		43

minimum. Lifelines should be prioritised pre event in terms of most necessary to affected people, often roading electricity and water, and most dependant so that these services can be repaired as soon as possible. Pre event installations of risk reducing equipment can also play a part ensuring lifelines are restores as quickly as possible.

One of the best ways to increase resilience in lifelines systems is to create redundancies, so that if needed damaged sections can be detoured until repairs are completed. This added to the success of the Northridge earthquake where the roading net works had sufficient redundancies that traffic could be offset onto other roads while the damaged section were repaired. This helps to reduce the effect the disaster has on transportation systems and means that supplies can be freighter in and out of the disaster area to help affected people and recovery the economy.

Conclusions

* Pre event planning for a post disaster situation combined with implementation of hazard mitigation techniques can reduce the effects of a disaster thereby reducing recovery time.
* The responsibility of pre event planning is shared collectively at government level and by different groups throughout the community.
* Pre planning of lifelines which need priority repair can ensure that critical services are restored as soon as possible and other services which have dependencies their restoration can be coordinated so as to cause the least amount of disruption possible.
* Lifelines which are an important part of recovery are highly interdependent. This interdependency means that communication between different lifeline groups is critical.
* Pre planning of priority lifelines opens lines of communication prior to the disaster which can make disaster communication less problematic.
* Using agencies in a post disaster situation to deal with situations they deal with on a day to day basis may cause problems. Many of these are government agencies and have responsibilities to the rest of country; however they will be aware of the procedures to be followed.

Chapter 7 - Discussion

Was the recovery of Napier in 1931 successful?

The Napier 1931 earthquake remains to this day New Zealand's worst disaster; did Napier make a successful recovery from this disaster? The town recovered from the devastation caused by the earthquake using new and innovative processes. Schwab et al (1998) outline four sets of decisions which are important to acknowledge when planning for a disaster:

5) Sites for temporary housing, relocation of damages businesses and dumping of debris
6) Closure of roads and bridges
7) Restoration or relocation of critical infrastructure
8) Reconstruction or relocation of dwelling units

Although Napier had no pre event plan in place before the earthquake, Nelson Park was set up as a site of temporary housing, just hours after the earthquake. Debris was cleared from the business district and deposited along the beach. Roads and bridges were temporarily closed and rebuilt. Critical infrastructure such as electricity, railway, and water was restored to the area within days of the earthquake and then full repairs were completed. Tin Town was built as a temporary CBD so that business could continue during the rebuilding of shops and offices. This shows swift action by the community of Napier which was helped by the experiences of the First World War. The experiences are probably the reason for some of the actions which occurred after the earthquake without prior planning. It is doubtful that this kind of action would occur today as very few New Zealanders have that kind of experience to draw back on.

In Napier a strong sense of leadership was present during the recovery with the Napier Citizens Committee formed the morning after the earthquake, the Earthquake Relief Committee formed soon after, along with the Napier Reconstruction Committee (Wright et al 2006). The Napier Borough Council handed power over to Commissioners who had control of the city and overall command of decision making.

These committees helped in making the recovery a success as they included mitigation measures and ensured public participation in their decisions. They also acted quickly without on ideas to ensure that what was planned was followed through on.

While the dumping of debris along the beachfront would not be allowed to happen now, it was approved in 1931 and along with the uplift of land provided an extra buffer between the town and ocean. Comparing what occurred in Napier to the decisions highlighted by Schwab et al (1998) then the recovery of Napier would seem to have been a success.

Schwab et al (1998) and Mileti (1999) define other important concepts that are particularly relevant during recovery:

- Consensus Building
- Providing Information
- Continuity of Procedures
- Planning Style

Rebuilding in the Spanish Mission and Art Deco styles was discussed with the public in Napier before the rebuilding, this was a positive step which resulted in this architectural style was welcomed by the residents of Napier. As well as it being the style of the times there were some pre earthquake buildings already in these styles. The local newspaper ran editorials on it as the architectural choice for rebuilding. Plans for rebuilding the CBD of Napier included public participation and compensation for property owners whose properties were needed to implement some of the rebuilding changes.

Information was readily available. The main form of information, the local newspaper who, just days after the earthquake printed leaflets with health warnings about boiling drinking water, and sanitation information to limit the spread of disease which was feared after the earthquake. The paper also warned people against looting and gave information on the rebuilding styles, this helped the police in their duties to control order and let the residents of Napier feel included in the overall decisions.

Essentially planning procedures were kept the same. There was less legislation to follow in 1931 than today, rebuilding in 1931 involved three Acts which were not closely related, while today at least five Acts which are designed to work closely together and additional plans are involved. However while the procedure was kept the same some shortcuts were taken when planning the CBD to reduce the amount of time for planning so that rebuilding could occur earlier. However time was still allocated for public participation during this planning process. The Commissioners who were given the same power and responsibilities as the Borough council consulted with the Mayor of the town in the decision making process to make sure the recovery was suitable for Napier. Shortcuts in the planning procedures show that pre event planning in this situation would have speed up the recovery further. This also shows that while it is important to begin to rebuild as soon as possible to recover the community and economy, public participation is a key feature in community acceptance of rebuilding styles.

While the traditional colonial street pattern of early Napier was kept after the earthquake it was changed to make the city more modern and functional for automobiles. Combined with the traditional layout were the new style buildings which mixed the English colonial style street pattern with the new American architectural style.

The main aim of Napier's rebuilding was to get businesses open as soon as possible, as shop owners could not afford to stay closed for long during the depression. Napier achieved its aim very successfully with a temporary town built to open shops as soon as possible, with the majority of shops open in permanent premises within two years of the earthquake. Private houses were not as affected as the CBD of Napier and repairs were completed as owners could afford during the depression.

The end of recovery in Napier was marked by the betterment and commemorative phase (Haas et al, 1997). This is shown by the development of Marine Parade which involved the construction of the sound shell, the Veronica Sun Bay in tribute to the help the town received from the sailors of HMS Veronica shown in Figure 21 and Figure 22.

Figure 21the sound shell on Marine Parade, Napier

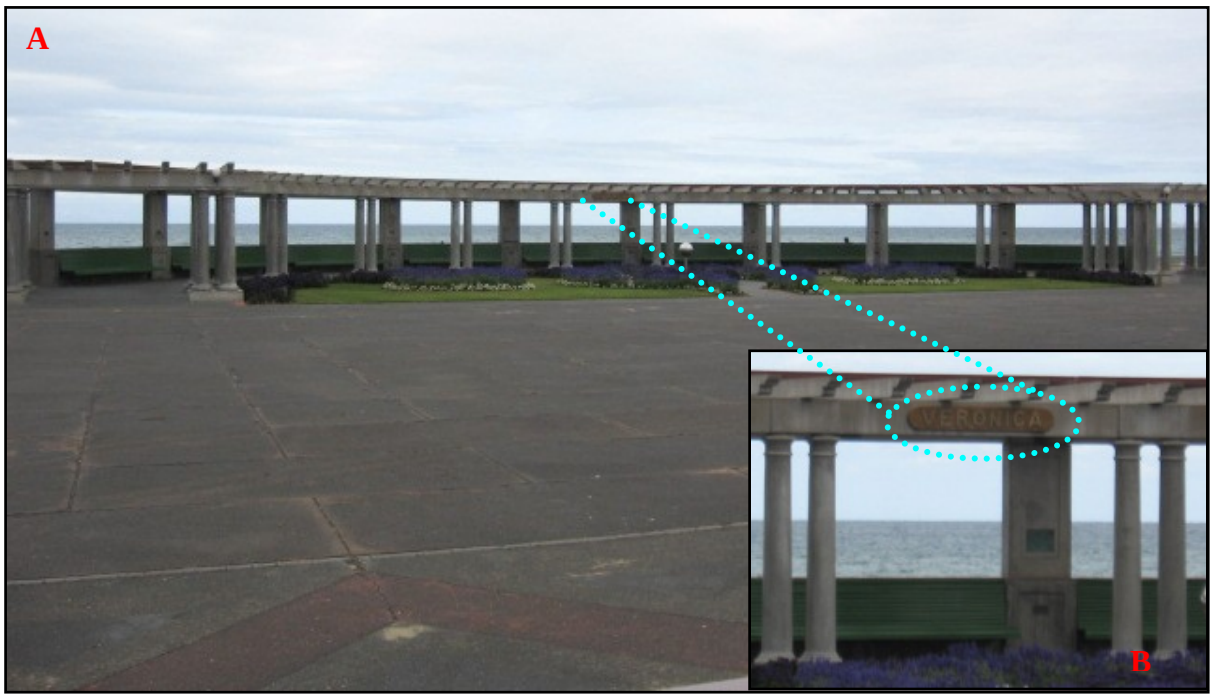

Figure 22 (A) Shows the Veronica Sun bay on Marine Parade Napier. (B) Inset shows the tribute to HMS Veronica, which the sun bay was named after.

Did recovery in 1931 improve resilience?

During the rebuilding of Napier, hazard mitigation measures were implemented into the rebuilding. Ying Wi and Lindell (2004) divide hazard mitigation techniques into:

- Community Protection Works
- Land Use Practices
- Building- Construction Practices

Napier's recovery did include measures to increase the resilience of the city. However as a result of the earthquake the suburb of Marewa and the airport were developed on the uplifted land. This uplifted area has allowed Napier to grow and develop to a large city however it has added to the future vulnerability of the city. Community protection works were undertaken after the earthquake however this was the repair of the flood banks which were damaged in the earthquake. Although later on in 1934 the Tutaekuri River was diverted so the uplifted land could be developed and flood risk the area would be reduced.

Land use practices were not used in the recovery of Napier. Napier pre earthquake development had been limited by the geography of the area, however with the uplift of new land Napier now had room to develop further. Over the years following the earthquake the uplifted land was prepared for development and the airport and a new suburb Marewa was developed. Unfortunately in 1931 the mechanisms that caused earthquakes were not known. It is now known through the study by Hayward et al, (2006) that subsidence is the normal trend for this area resulting in a large area of development on a block of land that could potentially subside several metres. However this area is extremely vulnerable to earthquake risk, a large proportion of residential properties have been developed here in addition transportation links including the airport, main rail and road links north pass through this area.

Figure 23 (A) Typical Napier street with continuous verandah heights. (B) Splayed corner, note the date on the building, the date of construction completion.

Building and construction practices were the main form of hazard mitigation employed during the rebuilding of Napier. This included the formation of a National Building Code and the use of reinforced concrete. Street widening had already been planned before the earthquake; this was to open the inner city up for traffic use but also as firebreaks. As many people in the earthquake were killed by falling structures, services such as power were put under ground. The new style of architecture excluded from its design ornamentation which could fall off during intense shaking Figure 23.

While Napier added some resilience measures to its recovery the effect of the earthquake has had a profound effect and disaster management in New Zealand. The Napier earthquake is responsible for the introduction of a building code, compulsory earthquake insurance and the formation of Civil Defence. It is also responsible for the allocation of emergency and disaster related government funding. These effects have had a major effect on New Zealand and have helped to increase the overall resilience of New Zealand to disasters, although while more is known about disasters and their causes New Zealand is by no means immune to the effects of natural hazards.

Would recovery now be similar to what happened in 1931?

New Zealand is vastly different now to what it was in 1931. Communities have changed; they are now more diverse and densely populated. Properties have increased in value with some New Zealand properties now worth than more than $1 million. As property values have increased so has the contents of people's home relative to 1931. Most families now have at least one car per family, when in 1931 many families did not a car at all. Many standard appliances did not exist in 1931 however, they are now commonplace in the majority of houses throughout New Zealand Communities are less self sufficient than there were in 1931. For example fruits and vegetables are available all seasons round, people are accustomed to a large range of convenience foods and rely heavily on electricity to cook, refrigerate and freeze food products.

At the present time more people own additional properties, either as a rental or holiday home. Investments in properties and contents have dramatically increased since 1931 meaning a large disaster today would have a higher cost than in 1931.

The people living in 1931 had lived through the First World War, with many serving overseas. After the earthquake many compared the devastation to what they had witnessed during the war (Wright, 2006). This kind of experience is probably partly responsible for some of the quick action especially during the response to the earthquake as many people had experienced a similar kind of situation. Today very few New Zealanders have experienced a comparable kind of situation and therefore maybe less inclined to act in the same way as the people of Napier in 1931.

While recovery in today's world would follow the same 4 steps of recovery, the overall process could be more complex than what occurred in Napier after the 1931 earthquake. The main legislation that dictated rules around recovery in 1931 was the Town Planning Act 1926, the new building code and the Hawke's Bay Earthquake Act 1931.

In New Zealand today there is more legislation to regulate the development and protect the environment. Rebuilding a town or city is now a more complex process, as rebuilding will need to follow the district and regional plans, the RMA, and the building code. This legislation has not been formed to be functional during recovery and as yet there are no provisions to short cut any lengthy processes to speed up recovery. The RMA and Building Act (2004) require every structure in need of rebuilding to apply for both resource consents and building consents. After the building work has finished these structures need to be inspected to ensure all standards have been met. During recovery this process will add time and will need additional people to complete these inspections.

District and regional plans are design to limit and control development for the protection of people and the environment. During recovery development needs to be facilitated in a controlled way so new mitigation measures may be put in place. Therefore the district and recovery plans should have similar objectives, however the district plan at this time lacks the tools to be able to integrate recovery into existing rules.

Disposing of rubbish and debris from a disaster also poses a greater problem than in 1931. Much of the debris from the Napier earthquake was dumped along the beach front. It is very unlikely that this activity would occur now. Only certain sites could be considered for debris disposal and again this would require resource consent and monitoring systems. This may be difficult to accomplish depending on how long debris clean up takes. In New Orleans debris is still being cleared 18 months after the hurricane (Office of the Federal Coordinator for Gulf Coast Rebuilding, 2007).

In normal times these systems work efficiently as there is only a certain amount of development and its rate is controlled by this legislation. However after a disaster there will be large populations of people needing to rebuild and therefore needing consents and inspections. It is likely the council in charge of issuing these consents may not be working to full capacity and may have lost records which will add extra time to recovery. While this kind of management is necessary for the protection and control of the environment, integrity of structures and development, it may not be the most practical way of control during recovery.

Materials may also be a problem more so now than in 1931. Forestry makes up a large proportion of our GDP, it is unlikely that New Zealand could process enough wood products to supply rebuilding after a major disaster and export for profit while still farming sustainably. Other resources such as aggregate for concrete may also run short if demand is high. However demand for materials will be dependant on the scale of the disaster and the style of rebuilding which occurs. This will be different for different regions throughout New Zealand.

In 1931 many lifeline services were government owned. This allowed these services to be fixed relatively quickly as the first commitment of government-owned companies is to its customers. Today many service companies are privately owned. This means often their first responsibility is to stakeholders and profit margins instead of customers. There may be delays with repairs as other companies or contractors may need to be contacted. There may also be a shortage of qualified people to fix some services, such as high voltage sub stations. This may add extra time to the restoration of these services.

Rebuilding of other government projects such as state housing, which did not begin until after the 1931 earthquake, would be different. This may adversely affect low income families. Instead of having suburbs of state housing the concept of pepper potting, spreading a few state houses throughout suburbs, would be preferred. The style of house would be different. As people now live more densely, state house sections would follow this trend, and retirement type accommodation would be more likely to replace family homes as New Zealand has an aging population (Tony McCleary, pers comms, 2007)

The effect of globalisation may also have a profound effect on recovery in today's society. The amount of global companies in New Zealand has certainly increased since the thirties. A major problem for New Zealand is that global companies may be able to recover their losses more rapidly than small local businesses. Therefore in a post disaster situation it may be harder for local businesses to rebuild and regain their client base as they may take longer to re-establish than global companies who have more resources at hand. Large global corporations are also more likely to have

business contingency plans than small owned and operated local businesses where this may not be a priority. Global companies may also hinder recovery as new rules or zones regarding their building or style of architecture may lengthen the process especially if this requires changes to their corporate image. Alternatively some global companies may chose to relocate their business to a less hazardous area which again may cause conflict during the recovery process. Therefore it is important to consider the effect that global companies will have in the recovery of cities.

Are pre event plans helpful during recovery?

Preparation of pre- impact recovery plans provides local officials with time to consider how the activities that take place during the immediate aftermath of a disaster will affect long term recovery (Wilson, 1991). Therefore pre event planning combined with pre event mitigation practises can further reduce the amount of time taken to recover by decreasing the number of people killed or injured and may also reduce the amount of damage experienced.

Geis (1996) and Haas et al (1977) suggest that recovery issues resolved in advance, by means of disaster scenarios will increase the efficiency and quality of post impact decision-making. The pre event plan used for the recovery of the Northridge earthquake allowed local officials to resolve planning issues before the disaster occurred, instead of trying to sort out problems following a disaster when intense pressure to resume pre disaster levels or accommodation and services and lack of time are obstacles to overcome (Ying Wi and Lindell, 2004). This is in direct contrast to Hurricane Katrina, where numerous issues and a lack of communication between recovery groups lead to an unsuccessful response and a slow start to recovery. Part of resolving issues that occur during recovery is interagency communication. Pre event planning can help to open these lines of communication and make points of contact before the disaster, therefore during and after the disaster contact people have already been established (Nigel Simpson, pers comms, 2007).

Other key features of pre event planning that have been highlighted include leadership, and the ability and knowledge to act (Rubin, 1985, in Ying Wi and Lindell, 2004). During the recovery of Napier strong leaders were capable of making

positive decisions for reconstruction, helping to speed up the recovery process. This differs to what occurred in New Orleans during and after Hurricane Katrina. Many of the leaders (State and Federal) failed to take action or left taking action too late, this was illustrated by poor pre event and post event evacuations in New Orleans, leaving thousands stranded in the city.

The recovery of Napier in 1931 was completed with very little pre planning. However the small amount of pre-planning that did occur was very successful in the overall recovery. The hospital had an emergency plan for evacuating and carrying for patients during a time of disaster which proved to be successful. Street widening was pre planed in the overall recovery of Napier. However societies are more complex and globalised now than in the 1930s, therefore pre event recovery planning reduce planning issues and time and help return to a pre disaster level of services quicker than if no pre planning had been undertaken.

Pre event plans can be designed for any disaster situation and can combine many groups and courses of action. The overall intended result of a pre event plan is to identify vulnerabilities and problems that may occur during a disaster and to attempt to remedy them before the disaster occurs. Pre event post disaster planning also follows this aim; however it endeavours to plan for the recovery of an area while there is time to think decisions through thoroughly. This was a major problem after the Boxing Day Tsunami where hasty decisions were made with regard to land access (Ingram et al, 2006; Oxfam International, 2006b). These decisions were rushed and were later withdrawn as they were not appropriate, slowed recovery and severely affected vulnerable communities.

Milteti (1999), Haas et al (1977) and Schwab et al (1998) outline basic requirements that should be included in a pre event plans. These requirements are general to any urban population needing to recover from a disaster. However in addition to these basic needs are things that will be specific to an area. This is where pre event planning becomes necessary at a small scale, as regional variations will result in different recovery strategies. Pro active recovery which results with pre event planning is less likely to result in poor decision making (Becker et al, 2006) Pre event planning can also give individual landowners more input into hazard reduction before a disaster

instead of imposing new laws and restrictions on people after the trauma of a disaster which may caused additional stress and anxiety to communities.

Could a recovery plan template be constructed for a NZ setting?

In New Zealand the majority of urban areas were established over 150 years ago, principally for convenience and without consideration of natural hazards (Becker et al, 2006). New Zealand is a unique country that is at risk to a wide range of natural hazards and many urban centres are at risk to a variety of these hazards. Pre event planning for recovery can be used as a tool to reduce the effects of a disaster and to help facilitate a successful recovery.

As New Zealand is a small country and is exposed to a wider range of hazards and has a smaller population to draw on in times of disaster. A major disaster would affect the whole country and may have devastating effects on New Zealand's primarily agriculturally based economy. Horticulture earns $4 billion per year for New Zealand and is important at the regional level for the jobs it creates (Jim Anderton, 2007). Many natural disasters may result in short and long term effects, this may affect agricultural land damaging crops, this occur during the Boxing Day tsunami as many orchards were inundated with sea water for many days killing plants (FAO, 2005). Other disasters such as weather events and volcanic eruption have devastating effects on agriculture. In addition to the effects on the land and stock a disaster many prevent harvests as there many not be enough people or machinery or lack of transportation may prevent stock being exported. After the disaster plants or animals may die meaning that areas need to be replanted or restocked, there may be a period of time before produce is ready for harvest again, for example some trees may not bear fruit in their first year resulting in long term effect of loss earnings (FAO, 2005).

Resources needed for a large scale recovery of an area may reduce or stop that activity in other regions. For example if rebuilding of large areas of housing, businesses and factories was required, this would take materials and trades people away from other areas throughout the country. As recovery will usually take a number of years this may limit any kind of development in other parts of New Zealand as the recovery area would become a priority. This kind of effect may flow on into other

areas of New Zealand life. However, it is likely that in this case New Zealand would receive help from other countries presumably Australia our closest neighbour.

Additionally there is the potential for a disaster to effect large parts of the country. When the Alpine fault in the South Island of New Zealand next ruptures a significant proportion of the Island will be in a state of simultaneous recovery.

For this reason pre event planning for natural disasters is something that should be taken very seriously in New Zealand. Pre disaster planning has the potential to reduce the effects of a disaster and to also ensure a more effective recovery especially if many urban areas require recovery simultaneously. The legislation in New Zealand gives local authorities the control of their own region. This means that these local areas are aware of the hazards they are at risk from and can plan in a way which suits their area. An example of this is in Central Otago where protection of the natural character of the landscape is important. Pre-event planning can ensure that the character of the landscape is preserved during recovery and the area is not exploited by development during recovery.

The basis of New Zealand's disaster management is the 4 R's. Lessons can be learned from Hurricane Katrina which shows how important reduction, preparedness and response are to the recovery process. In New Orleans no action was taken to reduce the risks from the inadequate protection from the levees, evacuation was not planned satisfactorily prior to the disaster and there was no plan on how to evacuate people after the event, this added to the poor response to injured and stranded people. Recovery has been slow, many people have not yet returned and it is likely that many will not return to New Orleans. The local officials, including police officers have lost credibility with the citizens and this has added strain to the recovery process. This example shows that incorporating reduction, readiness and response into pre event recovery plans can help to improve the overall recovery. Even if it simply ensures that the residents of the area continue to trust the decision makers, this will help reduce conflict that may arise during recovery decisions.

Legislation in New Zealand controls development and protects the environment. However as previously discussed this legislation is not designed to be incorporated

into recovery plans. Currently the best arrangement available to councils to include recovery plans is the LTCCP (Becker et al, 2006; Claire Hatfield and Angela Read, pers comms, 2007), however there are still drawbacks to using this plan for recovery. At present even if the LTCCP was used as a recovery plan it could not be used independently. Regional and District plans, the CDEM Act, Building Act and the RMA will still need to be used. If the LTCCP was used as a pre event recovery plan it may not coordinate effectively with this other legislation. It may also inhibit changes to this legislation which could improve recovery. Including recovery plans in the long term plan may also inhibit recovery as it may lengthen or disrupt some procedures such as identifying a debris disposal site and undertaking a feasibility study prior to a disaster. This may cause conflict with the community.

Conclusion

* The recovery of Napier after the 1931 earthquake was remarkably successful for an era where the community did not fully understand the mechanisms behind the disaster or had very little pre planning.
* Napier included in its recovery many mitigation factors which are surprising considering it was not known what caused earthquakes. The most impressive of these was the new national building code which required buildings to be earthquake resistant.
* The recovery of Napier would occur differently today as communities have evolved. There is more legislation to control clean up and rebuilding, more companies are privately owned compared to state owned service providers in 1931. There are also more globalised companies in today's cities which may conflict with recovery strategies.
* Pre event recovery plans help to resolve issues that may occur during recovery and help to make sound decisions after the disaster compared to hurried, unprepared choices. They are helpful during recovery to ensure that issues have already been addressed prior to the event and can help reduce the time taken to recover.
* A recovery plan for New Zealand can be constructed although it needs to take the form of a framework within which the individual systems that exist can address their own specific circumstances. Currently the best plan which could

accommodate a pre event recovery plan is the LTCCP although there are some drawbacks to using this as the basis for a recovery strategy.

* Where a large disaster could have a devastating effect on a large area for example the Alpine fault as well as local plans a national plan could be developed also.

Chapter 8 - Conclusions

Worldwide, the risks from natural and technological hazards has been mounting at an accelerating rate, improvements in forecasting and warning systems have reduced deaths, however monetary losses from disasters are overwhelming (Burby, 2004). Land suitable for development is becoming increasingly scarce and for this reason development often occurs on land subject to natural hazards. A natural hazard becomes a disaster when it affects community that is exposed to risk (Uitto, 1997; Alexander, 1993 in Cross, 2001).

Recovery takes occurs in two phases short term- where services are repaired and long term where the level of services are returned to the pre disaster level.

Pre event planning for recovery helps to resolve issues before the disaster so recovery is more efficient and effective. It also ensures that the window of opportunity can be used to implement hazard mitigation measures to reduce the vulnerability of the area with the aim of improving resilience for the next disaster. Two of the most critical processes to occur during pre event planning and recovery are strong leadership and communication between agencies that will enable the successful recovery of a community (Rubin, 1985 in Ying Wi and Lindell, 2004).

Northridge earthquake was the most successful recovery of the case studies as it showed that prior planning, effective response and attention to vulnerable populations to ensure that they recover along with the rest of the community leads to a successful recovery. Hurricane Katrina shows that a lack of pre planning, indecisive officials and a slow and ineffective response can have a dramatic effect on recovery. It is imperative that city officials act in the best interests for all residents. Many residents no longer trust the city officials and this has slowed recovery.

The lack of pre event planning before the Boxing Day Tsunami has slowed recovery as rebuilding has had to wait until plans are developed and formalised. In some cases there has been a lack of consultation with the community and this has added extra time to planning as conflict arises between the community and officials.

The recovery of the Napier 1931 earthquake was chosen as a New Zealand case study; to date this is the country's worst disaster. Over all the recovery of Napier was a success, shops were opened in temporary premises to keep the economy going, mitigation measures were included in the rebuilding. The earthquake has had important flow on effects to how disasters are managed in New Zealand. A new National building code was created after the earthquake and earthquake insurance became compulsory. The earthquake also played a part in the formation of Civil Defence and how disaster funding is allocated. If this recovery were to occur today it would be more complex as we live in different communities, have more contact with other countries and have more scientific understanding and legislation.

To create pre event plans in New Zealand legislation needs to be modified to include recovery plans and develop shortcuts to reduce some procedures which would lengthen the recovery process such as resource consents. These plans need to take into account our national vulnerability as well as regional vulnerabilities.

Recommendations for Further Work

The likelihood of a disaster that will affect a large area of New Zealand is a situation which needs more attention. This situation cover a broad range of topics that could each be investigated further for example the response to the disaster, the recovery and further effects to the economy, communities and environment.

More research is required to identify ways in which recovery legislation can be conveyed from the CDEM Act 2002 into local government policy without taking up enormous resources.

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Legislation

Building Act 2004

Building Code 1991

Civil Defence Emergency Management Act 2002

Hawke’s Bay Earthquake Act 1931

Historic Places Act 1993

Local Government Act 2002

Local Government Official Information and Meetings Act 1987

Resource Management Act 1991

Town planning Act 1926

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Appendix A

Legislation	Section/Part	Relevance to Natural Hazard Management
Resource Management Act 1991	Part 2	Part 2 explains the purpose of the Act and identifies matters of national importance and other matters e.g. climate change
	s30	States that Regional Councils have responsibility to control the use of use for the avoidance or mitigation of natural hazards.
	s35	Territorial authorities (district or city council) have to responsibility to control the effects of the use of the land for the avoidance or mitigation of natural hazards
	s59-62	Preparation of Regional Policy Statement, including reference to natural hazards
	s63-68	Preparation of Regional Plans in accordance with functions, this includes avoidance or mitigation of natural hazards
	s72-76	Preparation of District Plans in accordance with functions, this includes avoidance or mitigation of natural hazards
	s106	Subdivision consent can be refused, or granted subject to conditions, including conditions relating to natural hazards
	s220	Allow conditions to be placed on subdivision consents, including specific requirements
	s229	Purposes of esplanade reserves and esplanade strips to contribute to the protection of conservation values by, mitigating natural hazards
	s329-330B	Provides for the issuing of water shortage directions to apportion, restrict or suspend the taking, use, damming or diversion of water at any time there is a serious temporary water shortage; and resource consent exceptions for immediate preventative or remedial works as a result of natural hazards, and for works undertaken in accordance with the Civil Defence Emergency Management Act 2002.
	4th Schedule	Matters that should be considered when preparing an assessment of effects on the environment, any person preparing an assessment of the effects on the environment should consider any risk to the neighbour hood, the wider community, or the environment through natural hazards.

Appendix B

Social Dependency Matrix

Dependant on → / ↓	Civil Defence	Housing New Zealand	WINZ	District Health Board	Local Hospitals	National Hospitals	Inland Revenue	Insurance Providers	Police	CYF	Salvation Army	Red Cross	RNZSPCA	Media	St John Ambulance	Fire Brigade
Civil Defence		5	4	5	5	3	3	3	5	2	5	5	3	5	4	4
Housing New Zealand	4		5	2	2	2	4	3	3	3	4	4	2	4	1	2
WINZ	5	5		2	3	3	5	3	3	4	3	3	2	4	1	1
District Health Board	5	2	3		5	5	3	4	3	3	4	4	1	4	2	1
Local hospitals	5	2	3	5		5	3	4	3	3	3	3	1	4	4	1
National Hospitals	4	2	3	5	5		3	4	3	3	3	3	1	4	3	1
Inland Revenue	3	4	4	2	2	2		3	2	3	3	3	1	3	1	1
Insurance Providers	4	3	2	4	3	3	2		2	1	2	2	3	3	1	3
Police	5	2	2	3	3	3	2	2	0	3	2	2	2	4	5	5
CYF	3	3	4	3	3	3	3	1	2		3	3	1	4	1	1
Salvation Army	5	4	4	4	4	2	2	2	2	2		4	1	4	1	1
Red Cross	5	4	4	4	4	2	2	2	2	2	2		1	4	1	1
RNZSPCA	4	1	1	1	1	1	1	1	1	2	1	2		3	1	1
Media	5	4	4	5	5	5	3	4	5	4	5	5	4		3	3
St John Ambulance	4	1	1	3	5	5	1	2	3	2	2	2	1	3		5
Fire Brigade	4	2	1	2	1	1	1	3	5	1	1	2	1	3	5	
Total	65	44	45	50	51	45	38	41	44	38	43	47	25	56	34	31

Scale

1= Low Level of Communication
5= High Level of Communication

Economic Dependency Matrix

Dependant on →	Civil Defence	Minister of Finance	Ministry of Social development	New Zealand Trade and Enterprise	Ministry of Economic development	Inland Revenue	Insurance Providers	Non- Governmental organisations	Business associations	Local Business	International Corporations	Federated Farmers
Civil Defence	0	5	5	3	5	2	2	4	4	5	3	5
Minster of Finance	4	0	5	4	5	5	3	4	4	1	4	4
Ministry of Social development	4	5	0	4	5	5	5	4	5	2	3	4
New Zealand Trade and Enterprise	3	4	3	0	5	4	5	3	5	3	5	5
Ministry of Economic development	5	5	4	4	0	5	3	4	5	3	5	5
Inland Revenue	3	4	4	4	4	0	2	3	3	3	3	3
Insurance Providers	2	2	2	2	3	3	0	2	3	4	3	4
Non- Governmental Organisations	3	4	4	5	5	3	3	0	3	3	3	3
Business Associations	3	2	5	5	5	3	4	3	0	5	4	3
Local Business	3	1	3	4	4	4	4	4	5	0	3	3
International Corporations	4	2	2	3	4	4	4	4	4	2	0	1
Federated Farmers	4	2	4	3	4	3	4	3	4	4	3	O
Total	38	36	41	41	49	41	39	38	45	35	39	40

Natural Dependency Matrix

Dependant on →	Department of conservation	Regional Council	District Council	Engineers	Environmental Risk management agency
Department of Conservation		5	5	4	3
Regional Council	4		5	3	3
District Council	3	4		3	3
Engineers	4	4	3		5
Environmental Risk management agency	4	4	4	5	
Total	15	17	17	15	14